

# Analysis Performance

## ✓ PREPARATION



In the knee flexion the hamstring (semitendinosus, semimembranosus, biceps femoris) acts as the prime mover, and the quadriceps acts as the antagonist. The quadriceps is undertaking an eccentric contraction.

In the hip extension the gluteus maximus acts as the prime mover and the psoas and iliacus are the antagonists.

In the hip flexion the psoas and the iliacus (iliopsoas) are the prime movers and the gluteus maximus acts as the antagonist. It moves in the median plane around the transverse axis.

In the ankle, plantar flexion happens so the prime mover is the gastrocnemius, and the tibialis anterior acts as the antagonist.

In the knee extension the quadriceps (rectus femoris, vastus medialis, vastus lateralis, vastus intermedius) acts as the prime mover, and the tensor fasciae latae helps the quadriceps as a synergist.



## ✓ PREPARATION



In the extension of the knee the quadriceps group acts as the prime mover and the hamstrings group are the antagonists. It is moving around the transverse axis, in a median plane. The quadriceps is undertaking a concentric contraction so the hamstrings are lengthening.

In the hip flexion the psoas and the iliacus are the prime movers and the gluteus maximus acts as the antagonist. Movement is in the median plane and it moves around the transverse axis.

The knee is starting to be flexed, the prime mover will be the hamstring and the antagonist the quadriceps.

In the hip extension (right) the gluteus maximus acts as the prime mover and the psoas and the iliacus are the antagonists.



## ✓ EXECUTION



The angle of the lead leg has not really changed, therefore, isometric contraction of the muscles surrounding the knee takes place.

Knee flexion performed by the hamstrings (semitendinosus, semimembranosus, biceps femoris) acting as the prime mover, and the quadriceps acts as the antagonist.

In the hip flexion initiates the movement so the psoas and the iliacus are the prime movers and the gluteus maximus acts as the antagonist. However, abduction and medial rotation take over as the leg is brought round in a cyclical action. The gluteus medius would become the prime mover



## ✓ RECOVERY/FOLLOW-THROUGH



In the hip flexion the psoas and the iliacus are the prime movers and the gluteus maximus acts as the antagonist. It has a median plane and it moves at its transverse axis.

Knee flexion – caused by the hamstrings (semitendinosus, semimembranous, biceps femoris) acting as the prime mover, and the quadriceps group acts as the antagonist.

The knee is starting to flex as it is being brought towards the ground so slight flexion of the knee is happening (although it is hard to see). It is moving in a transverse axis, a median plane. However, when the left leg touches the ground there will be an eccentric contraction of the quadriceps acting as a brake.





## PREPARATION



The initial take-off phase for both the elite performer and myself look very similar. The take-off leg shows good extension due to a large force being applied to the track. Therefore, as stated by Wiggins-James et al (2009) Newton's third law will be applied with the benefit being a resulting powerful reaction force to generate height to clear the hurdle. However, the height of my lead knee is greater than Sally Pearson, this means that my take off angle is too steep; therefore I clear the hurdle by an unnecessary margin. My coach has also highlighted this as an area of development and has stressed the need to correct it to make significant improvements. We can see that both of us are starting to move the right arm towards the left leg to maintain balance throughout the splitting phase<sup>1</sup>. Furthermore, the arm and leg action match closely to normal running form (right arm forward with left leg and vice-versa on the opposite side) thus contributing to efficient economy of movement with reduced energy wasted.

Perhaps the take off leg is slightly too far away from the hurdler which as explained by Allison (2015) will contribute to too much vertical height over the hurdle. 216

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<sup>1</sup> Splitting phase - the phase where your trail leg is completely 'straight' and your trail leg perpendicular to the ground

## PREPARATION



Both our leading leg is extended in front of the body but full extension is not achieved thus enabling the foot to be brought to the ground quicker to continue the race at a high velocity. Hintz et al. (2012) explains that the benefit of this technique is less time spent in the air - too much time in the air will mean time wasted during the race, and less time sprinting. Pearson benefits from flexing the trunk closer to her knee than myself to reduce air resistance by lowering her centre of mass, which allows minimal clearance of the hurdle and a more aerodynamic posture. 102

## EXECUTION



Both athletes' trail leg are abducted out to the side almost perpendicular to the ground enabling good clearance of the hurdle, however, as illustrated by the lines on the pictures Pearson's is marginally more precise in her position.

There are a few differences; compared to myself Pearson maintains the arm under better control. Whereas, my slightly loose arm can negatively affect my balance, and therefore aerodynamic speed. Keeping the centre of mass as low as possible, leaning forward (allowing for easier movement of the trail leg) and keeping vertical velocity low (allowing for less time in the air) are all advantages highlighted by Hintz et al. (2012). Finally, Pearson tucks her lead arm in closer to the body to create less air resistance.

## RECOVERY/FOLLOW-THROUGH



During the recovery phase I become slightly more unbalanced than Pearson, therefore losing speed. To improve, I should bring the lead arm down quicker to help force/snap the lead leg down to the ground faster to get back to the track sooner and back into the sprint. In comparison, my right arm is higher thus contributing to my bodyweight moving too far back. Whereas, Pearson brings her arm down quicker to the ground to help maintain better posture and her bodyweight further forward. Therefore, upon landing she will be able to push off with greater power and maintain running velocity. 100





McGill (2005) emphasises the importance of minimising head movement while hurdling. The diagram above demonstrates how I maintain the same head height, and as he recommends, my eyes are focused on the next hurdle. This prevents the head dipping and thus the lead leg pausing as much so less time is lost. 50

The table below includes a number of possible hurdle drills. Hoddle (n.d) recommends focusing on drill numbers 6, 7, 8 and 9 to develop hurdle clearance. My coach has agreed that these will be suitable exercises to include into my weekly schedule to improve my speed over the hurdle. Furthermore, he will record my performances during training using a free app: iMotion HD (Freemake n.d.). This will allow instant feedback so I can work immediately on the next corrective measure, such as greater flexion of the trunk aiming to clear the hurdle by a minimal margin. 92

**Drill Number 1**

*Hurdling with the hurdles placed up to 8.25m apart. Improves: Beginners Avg. Speed*

**Drill Number 2**

*Running over low hurdles, 30", with the hurdles placed up to 8.25m apart. Develops running rhythm*

**Drill Number 3**

*Hurdling in a 5-Stride rhythm over hurdles placed 11.5 to 12m apart. Improves: Avg. Speed, stride frequency*

**Drill Number 4**

*Hurdling with a gradual shortening of the distance between the hurdles from 8.50 to 8.10m by 10cm at a time. Shortens stride length and increases avg. speed*

**Drill Number 5**

*Hurdling over different height hurdles-30" to 33". Shortens support phase, lengthens flight phase- 33" Opposite 30"*

**Drill Number 6**

*Running over the hurdle with the lead leg going past the hurdle. Increases: speed-stride frequency*

**Drill Number 7**

*Running in a 3-stride rhythm with the clearance of imaginary hurdles. Shortens flight distance and time.*

**Drill Number 8**

*Hurdling on a track with a 2 degree incline from the point where the avg. Speed begins to drop. (3rd hurdle). Decreases speed loss*

**Drill Number 9**

*Towed hurdling. Reduces time between the hurdles. Increases speed over the hurdles.*

The table includes a number of hurdle drills to develop performance (Hoddle n.d.)

## COMPONENTS OF FITNESS MOST IMPORTANT IN HURDLING:

### Speed

When assessing the importance of different components of fitness it is necessary to understand the nature of the event. McDonald (2012) insists that being a good sprinter is a prerequisite for being a successful hurdler. Cotto (n.d) agrees that sprinting prowess is crucial because it is an all-out sprint from beginning to end. The objective is to reach the finish line as fast as possible, therefore, I have chosen speed as one of my main fitness components. Furthermore, he explains that the significantly lower hurdle height for women allows them to maintain a more natural sprint stride as they hardly have to elevate their hips to clear the hurdle emphasising the need for speed. 114

## USATF 2008 Olympic Trials Splits

USATF 2008 Olympic Trials Women's 100m finals								
prepared by USATF Women's Sprint Development w/HPC - Wind +1.0								
LANE	1	2	3	4	5	6	7	8
m	A Williams	L Williams	M Lee	T Edwards	M Hooker	M Lewis	L Moore	A Felix
10	2.03	2.06	2.07	2.03	2.14	2.04	2.16	2.12
20	3.10	3.15	3.15	3.12	3.24	3.13	3.27	3.20
30	4.12	4.15	4.14	4.08	4.21	4.15	4.32	4.20
40	5.11	5.13	5.15	5.09	5.19	5.15	5.30	5.18
50	6.05	6.06	6.07	6.04	6.12	6.08	6.28	6.12
60	7.00	6.99	6.98	6.97	7.07	7.05	7.22	7.09
70	7.97	7.94	7.94	7.91	8.00	8.03	8.21	8.04
80	8.97	8.91	8.89	8.88	8.96	9.01	9.19	9.01
90	9.97	9.88	9.84	9.88	9.90	10.03	10.14	9.94
100	11.02	10.90	10.85	10.90	10.93	11.08	11.22	10.98
Placing	6	3	1	2	4	7	8	5

Courtesy of SpeedEndurance.com

Split times for all 8 athletes competing in 2008 Olympic 100m female hurdle final (Lee 2011)

30m Sprint	Attempt 1	Attempt 2	Attempt 3
My scores	4.51	4.53	4.54

### Validity

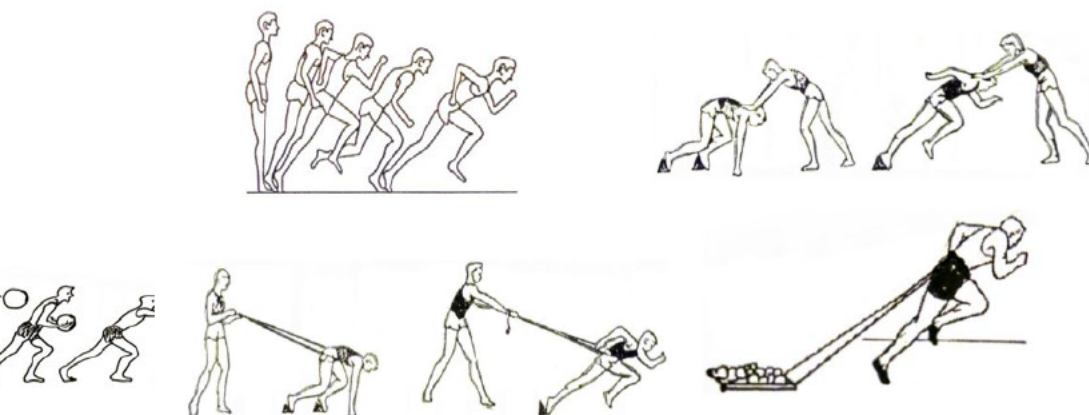
To measure speed Iskra et.al (2006) claim sprints between 30-100m are the most valid speed tests. Therefore I've selected the 30m sprint test. Accelerative speed is important for success in hurdles due to the short duration of the event. The test not only measures the ability to get to top speed but as stated by Dick (1987) it provides a good indication of the potential future performance of an athlete. Mangiacotti (2011) highlights other factors that contribute to the outcome of this test to include power, coordination and reaction time, thus reducing the validity of the test but believes it is still relevant to hurdles as an indicator of accelerative speed. My speed of 4.51 compares quite well with T. Edwards time of 4.08 but shows I have a huge amount of

speed training to do to reach this level! 132

## Reliability

The use of manual timing (used to measure my speed) does not eliminate reaction time and also increases timing errors. Whereas, Haugen & Buchheit (2015) recommend the use of fully automatic timing systems to improve accuracy, however, this was not possible. Haugen & Buchheit (2015) stresses that the type of surface chosen can cause dramatic differences. Therefore, I chose a tartan running track for the test and wore my hurdle clothing and spikes all of which were consistent with the elite performers protocols.

Rautenbach (n.d) states that there are training methods that will help you improve the start and thus develop accelerative speed. Exercises such as stick drills, partner drills, harness drills, medicine ball or pull sledge. All these exercises consist of applying resistance to the athlete to develop the neuromuscular link; Halfmann (2012) stresses that contrast training<sup>2</sup> is performed immediately after the resistance work to ensure the nerve impulses fire quickly and thus improve speed. 155



Selection of resistance exercises to develop speed Rautenbach (2012)

## Anaerobic capacity

The 100m hurdles involves the anaerobic metabolism contributing in excess of 90% and as Iskra et al. (2006) state anaerobic capacity and power are the most important when considering success in sprint hurdles. Therefore, I have chosen anaerobic capacity as one of the most important components of fitness. 44

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<sup>2</sup> Contrast training – the same drill is performed but without the resistance

## CALCULATIONS

### 1. Peak power output

$$\begin{aligned}
 PP &= \text{Force} \times \text{Distance} \div \text{Time} \\
 &= (5.5 \text{ kp} \times 9.8 \text{ m} \cdot \text{s}^{-2}) \cdot (12 \text{ rev} \cdot 6 \text{ m/rev}) / 5 \text{ s} \\
 &= 776.8 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-3} \\
 &= 776.8 \text{ N} \cdot \text{m} \cdot \text{s}^{-2} \\
 &= 776.8 \text{ W}
 \end{aligned}$$

### 2. Relative peak power output

$$\begin{aligned}
 RPP &= PP \div \text{Body mass, kg} \\
 &= 776.8 \text{ W} \div 73.3 \text{ kg} \\
 &= 10.6 \text{ W} \cdot \text{kg}^{-1}
 \end{aligned}$$

### 3. Anaerobic fatigue

$$\begin{aligned}
 AF &= (\text{Highest PP} - \text{Lowest PP}) \div \text{Highest PP} \times 100 \\
 [\text{Highest PP} &= \text{Force} \times \text{Distance} \div \text{Time} = 5.5 \text{ kp} \times 9.8 \text{ m} \cdot \text{s}^{-2} \times (12 \text{ rev} \times 6 \text{ m}) \div 0.0833 \text{ min} \\
 &= 4753.9 \text{ kp} \cdot \text{m} \cdot \text{min}^{-1}, \text{ or } 776.8 \text{ W}] \\
 [\text{Lowest PP} &= \text{Force} \times \text{Distance} \div \text{Time} = (5.5 \text{ kp} \times 9.8 \text{ m} \cdot \text{s}^{-2}) \times (5 \text{ rev} \times 6 \text{ m}) \div 0.0833 \text{ min} \\
 &= 1980.8 \text{ kp} \cdot \text{m} \cdot \text{min}^{-1}, \text{ or } 323.7 \text{ W}] \\
 AF &= 776.8 \text{ W} - 323.7 \text{ W} \div 776.8 \text{ W} \times 100 \\
 &= 58.3\%
 \end{aligned}$$

### 4. Anaerobic work

$$\begin{aligned}
 AW &= \text{Force} \times \text{Total Distance (in 30 s)} \\
 &= (5.5 \text{ kg} \times 9.8 \text{ m} \cdot \text{s}^{-2}) \times [(12 \text{ rev} + 10 \text{ rev} + 8 \text{ rev} + 7 \text{ rev} + 6 \text{ rev} + 5 \text{ rev}) \times 6 \text{ m}] \\
 &= 15,523 \text{ joules, or } 15.5 \text{ kJ}
 \end{aligned}$$

**TABLE 11.2 • Percentile Norms for Average Power and Peak Power for Physically Active Young Adult Men and Women**

%	Average Power Watts (W)		Peak Power Watts (W)	
	Male	Female	Male	Female
90	662	470	822	560
80	618	419	777	527
70	600	410	757	505
60	577	391	721	480

Subject #1: \_\_\_\_\_

PP = \_\_\_\_\_ Rank = \_\_\_\_\_%

RPP = \_\_\_\_\_ Rank = \_\_\_\_\_%

AF = \_\_\_\_\_%

Subject #2: \_\_\_\_\_

PP = \_\_\_\_\_ Rank = \_\_\_\_\_%

RPP = \_\_\_\_\_ Rank = \_\_\_\_\_%

Table for working at formulae for test scores in the Wingate test

Wingate test	Peak Power	Relative Power	Anaerobic work/capacity
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<b>Calculations</b>	<p>Peak Power = (Force x distance) / time</p> <p>Force = 3.9 (0.075 x 52 my body weight) x 9.8 (gravity)</p> <p>Distance = no. Of revolutions x distance travelled per revolution (6m )</p> <p>Distance = 12 x 6 = 72 for example</p> <p>Time = 5s for PP</p> <p>So 38.22 (3.9 x 9.8) x 72 (10 x 6) = 2751. 84 / 5 = <b>550.368 W</b> (top 80% of active young female adults)</p>	<p>Peak Power / body mass (kg)</p> <p>550.368/52 = 10.584</p>	<p>Force x Total distance (in 30s)</p> <p>3.9 x 9.8 = 38.22</p> <p>x</p> <p>(12 rev + 10 rev + 8 rev + 7 rev + 6 rev + 5 rev) x 6</p> <p>= 288</p> <p>38.22 x 288 = <b>11007.36</b> joules or <b>11 KJ</b></p>
<b>My scores</b>	<b>550.368 W</b>	<b>10.584 W</b>	11007.36 joules
<b>Polish hurdlers scores</b>	<u>884.0 ± 119.7</u>		20.65J

**Table 2**

Analysis of variance (ANOVA) of Wingate test variables

Variable	H <sub>1)</sub>	Training Period			F	p
		General Preparation	Specific Preparation	Transition		
Total work (kJ)	1	20.65 ± 2.45	20.54 ± 2.12	20.30 ± 2.04	0.137	.872
	2	20.40 ± 2.02	19.91 ± 1.84	20.07 ± 2.23	0.359	.699
Relative total work (J/kg)	1	271.9 ± 17.2	272.1 ± 1.56	266.0 ± 14.0	0.736	.483
	2	281.5 ± 17.6	275.6 ± 13.5	276.5 ± 19.2	0.820	.445
Peak power (W)	1	884.0 ± 119.7	847.3 ± 93.0	854.9 ± 99.6	0.740	.481
	2	845.2 ± 89.8	824.2 ± 82.2	827.5 ± 88.7	0.405	.668
Relative peak power (W/kg)	1	11.64 ± 0.91	11.22 ± 0.75	11.23 ± 0.77	1.820	.171
	2	11.66 ± 0.82	11.41 ± 0.60	11.41 ± 0.83	0.888	.416
Fatigue index (%)	1	23.67 ± 5.65 <sup>2)</sup>	20.19 ± 3.70	21.62 ± 5.43	2.765	.048
	2	20.13 ± 6.64	20.12 ± 3.97	19.38 ± 4.57	0.167	.847
Time of peak power attainment (s)	1	4.93 ± 1.05	5.77 ± 1.33	5.47 ± 1.19	2.863	.044
	2	5.49 ± 1.24	5.53 ± 0.71	5.64 ± 1.29	0.124	.882
Time of peak power maintenance (s)	1	3.45 ± 0.79	3.89 ± 0.92	4.15 ± 1.33	2.430	.966
	2	3.88 ± 1.01	4.00 ± 1.05	3.82 ± 1.32	0.149	.862

<sup>1)</sup> – hurdles distance: 1 – 110-mH, 2 – 400-mH

<sup>2)</sup> – statistical differences 110-m and 400 m hurdlers (t – Student for independent variables), p ≤ 0.05

Table 1. Peak power output norms for active young adults (11).

Percentile Rank (%)	Male (Watts)	Female (Watts)
90	822	560
80	777	527
70	757	505
60	721	480
50	689	449
40	671	432
30	656	389
20	618	376
10	570	353

Peak Power Output norms for active young adults (ScienceforSport n.d)

## Validity

The Wingate test has been confirmed by Iskra et al (2006) as a suitable, reliable and popular test to measure anaerobic capacity and power in hurdlers. Furthermore, they state that the contribution from anaerobic metabolism is between 55-87% during the 30s Wingate test. Therefore, is comparable with the physical requirements of sprint hurdling. Science for Sport (n.d) provides further evidence that supports the validity of this anaerobic test by claiming it as reliable for activities of power and anaerobic capacity. The average age of the Polish elite male athletes (there is no data available for females) was 20 which is 3 years more than myself and so predictably far higher than my scores. Therefore, my peak power and anaerobic capacity scores of 550W and 11KJ respectively provide little information. However, compared to the data from active young adults I fall into the upper 80% percentile ranking. 138

## Reliability

I used the Monarch bicycle ergometer (the same as the one used in the Polish hurdlers study) to allow for comparison between results. Like the Polish study, I performed the test during the general preparation period (December) to allow for direct comparisons. Also, I performed a 3-5 min warm-up prior to exercise as recommended by Cune (n.d). In conclusion, Pavlovic et al. (2016) recommends the RAST as more suited to hurdling because it involves sprinting however, there are no available data scores from hurdlers, therefore I chose the Wingate test. 84



My coach creates training sessions where we focus more on maintaining speed for longer (anaerobic capacity). For example, 2 sets of 300m + 250m + 200m + 150m; resting time in between series 4min, in between blocks 10min. This training focuses more on speed endurance and thus will enable me to obtain a greater amount of energy from anaerobic sources. I will aim to push myself harder particularly during these workouts to raise my anaerobic capacity. 76

## **Flexibility**

Hill et al (2008) defines flexibility as, 'the range of movement available at a joint' (pg 71). McDonald (2012) argues that flexibility is actually much more important than jumping ability. One reason for this is significant flexibility enables an athlete to only raise their center of mass the minimum required to clear the hurdle. Furthermore, Cotto (n.d) supports this view by saying that nearly every World record holder can perform the splits. 62

Descriptive data for AROM among female athletes.

	Runners (n=36)		Jumpers (n=11)		Throwers (n=13)	
	Dominant	Non dominant	Dominant	Non dominant	Dominant	Non dominant
Mean	69.6°	69.5°	73.2°	72.3°	69.1°	69.5°
SD	5.7	5.9	5.8	5.7	5.8	5.6
95% CI (mean)	67.7–71.5	67.6–71.4	69.8–76.6	68.9–75.7	66.3–72.7	66.5–72.5
95% CI	58.2–81.0	57.7–81.3	61.6–84.8	60.9–83.7	57.5–80.7	58.3–80.7

Active Range of Motion scores for elite female track and field athletes in the Active Knee Extension (AKE) test  
Malliaropoulos (2015)

AROM test	Dominant	Non- dominant
My scores	68.2	68.1

## **Validity**

I chose the AKE test because it measures posterior thigh flexibility, which is important as Malliaropoulos et al. (2015) state, to facilitate effective hurdling technique and injury prevention. Limited hamstring flexibility forces the hip flexors and quadriceps to contract more; the result is wasted energy due to inefficiency and a reduction in the speed in which the leg is raised.

The data above is from elite female track and field athletes and does include hurdlers so is specific to my event. This is the first study of its kind so there is a lack of normative data relating to flexibility of the posterior thigh in track athletes. My scores of 68.2 and 68.1 compare well with the runners (includes hurdlers) scores of 69.6 and 69.5 suggesting I possess sufficient flexibility to perform at a high level. 132

## Reliability

Fortunately, my physiotherapist (with many years experience) carried out the measurement process using goniometry. Furthermore, the AKE test was carried out during the in-season, with a prior warm-up and the room temperature was similar to that conducted in the Malliaropoulos (2015) study. Measurements were taken using equipment like in the pictures below. The physiotherapist ensured that my thigh remained at 90 degrees of flexion throughout the movement, two measurements from each leg were obtained and then averaged. This test is particularly specific to my condition at present as I am recovering from anterior cruciate ligament surgery and thus the results show that I have recovered mobility in my leg. 107



## Physiological component

Word Count: 1044 (excluding references, tables of data, charts, headings, footnotes & bibliography)

## Technical component

Word Count: 679 (excluding references, tables of data, charts, headings, footnotes & bibliography)

**Total word count: 1723**



# Performance Development Plan

## Planning

**Objective: To develop strength, speed and return to competitive hurdling by the end of a post ACL reconstruction rehabilitation programme.**

After evaluating my performance analysis I wanted to improve my accelerative speed, due to the results in the 30m sprint test (4.51-4.54). However, since the completion of my Performance Analysis I have been forced to adapt my training, due to the unfortunate injury and surgery of my Anterior Cruciate Ligament. Therefore, I will devise a rehabilitation programme based on the timeline suggestions of Kennedy (2009) that will focus on the following areas: strength, speed and proprioceptive training as well as returning to competitive sport. 84

The need to exercise caution is paramount when planning a post ACL reconstruction rehabilitation programme due to the scary statistics of reinjury. Wiggins et al.'s (2016) meta-analysis shows that athletes younger than 25 years old returning to sport have a secondary ACL injury rate of 23%. Therefore, I will need to carefully monitor my progress to ensure I do not return to competitive racing too soon. 63

Hill et al. (2009) states that goal-setting could be used as a psychological tool to structure training programmes and motivate individuals. Initially, I would have set myself a target to go under 4.30 in the 30m sprint test to focus on accelerative speed. However, due to my severe ligament injury, I am setting a more conservative time of 4.60. Recording fitness test scores pre, mid and post development plan, along with writing the number of repetitions, sets, training intensities and distances achieved during each individual session will enable me to measure progress. I will ensure that the targets reflect my current condition; lowering the scores to make them achievable, due to the significant loss in knee strength, should maintain my achievement motivation. My surgeon said that realistically it would likely be 8 months to 1 year before I regain full fitness. Therefore, by the end of a 10 week training programme it will be 8 months since the surgery. Consequently, the target times seem reasonable given the time scale I am working under. 171

Although my hurdling skills are fairly grooved, Dhillon et al. (2011) believes that after an ACL injury, loss of proprioception can significantly contribute to mechanical instability in the knee and lead to secondary injuries. Furthermore, studies by Parus et al. (2015) show that static postural control and proprioception is lost after ACL surgery, due to injury of the mechanoreceptors. The lack of proprioceptive information<sup>3</sup> may result in reduced neuromuscular control of the knee stability. Therefore, emphasising the need to include specific hurdling technique drills to develop proprioception. 79

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<sup>3</sup> (changes in tension, speed, acceleration, direction of movement and position of the knee)

## Methods of Training and Principles of Training

Gunter (2016) states that women are more prone to suffering ACL injuries because of a slower muscle firing rate, therefore, I have decided to include an element of plyometric training to my Development Plan which is in line with the recommendations from Davies et al. (2015) to increase neural efficiency. Plyometric exercises should increase the rate at which my motor units are able to recruit muscle fibres, thus reduce the 23% chance of suffering a second ACL injury. 72

In order to increase my proprioception post-injury, I will include the use of BOSU boards in my training routine, to increase my joint stability and overall proprioceptive awareness, as recommended by Miller (2018). Moreover, the later stages of a rehabilitation programme, such as mine require proprioceptive training to improve the dynamic stability of the knee. 53



Pictures above of me performing different proprioceptive exercises on the BOSU and swiss ball

I decided to include proprioceptive exercises using a BOSU<sup>4</sup> and swiss ball to increase proprioceptive awareness but also cope with high peak forces by applying correct landing mechanics as recommended by Roscoe & Roscoe (2017). 30

Most exercises place a heavy emphasis on the lower body due to the explosive demands of this area on hurdling. An example of a suitable exercise involves standing on one leg on a BOSU board while trying to touch a imaginary object positioned in front and then returning to a running position (leading leg) to jump a hurdle. This actions makes it specific to correct hurdling mechanics and should speed up the proprioceptive memory of the movement. 77

The Swiss ball exercise targets the hamstrings group and core muscles both important to maintain correct hurdling form. Furthermore, Biswas (2018) explains how the instability improves the effectiveness of the exercise by recruiting small muscle fibres of the core. 37

I have introduced weighted sleds and assisted training into the second and third mesocycles when I believe the knee will be able to withstand higher stress levels. Zafeiridis et al. (2005) In Avila (2016) discovered in a study that acceleration over 20m improved with a weight of 5kg. As I need to accelerate and then maintain speed over 100m I will aim for similar loads. 58

Avila (2016) states that Hill Sprints are perceived as an essential part of an effective speed training program to build acceleration and maximal velocity. Therefore, I included hill sprints but on sand to further lessen the impact on the joints. 38

The traditional short interval speed training features in every session. However, the speeds are likely to be less than the usual maximum. Furthermore, I have included longer distance (150-200m) sprints due to my current condition and the need to improve my speed endurance. Typically the rest time in the individual sessions will include a 1:5 work:rest ratio. or 2 mins recovery between sets to replenish the phosphocreatine stores. Hurdle drills have been included to maintain good mechanics along with continuing the development of the proprioceptors. 87

I will also use a combination of strength exercises ideally focused around the 5-8 repetition range to increase my power and therefore my 10m acceleration, as proven by Lockie (2017) to be effective in developing accelerative speed. However, it is probably too soon for such low repetitions and heavy loads, therefore, a 12-15 range will be more prudent. I will include exercises, such as back squats and cable hip flexion to increase power when exploding out of the starting blocks. Lockie (2017) claims that an additional benefit of the cable hip flexion exercise is to “increase step frequency and

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<sup>4</sup> BOSU (stands for Both Sides Utilised) is a gym tool used for building strength and balance

lengthen the step". Whereas, absolute and relative strength measured through back squats is positively correlated with sprint acceleration. <sup>113</sup>

I have varied the method of training and the exercises within these methods to provide variance. Roscoe and Roscoe (2016) justify the use of this principle of training to avoid overuse injuries associated with using the same exercises which is particularly relevant to my current condition, as well as maintaining motivation for the performer. I have been used to training six days a week (2hr sessions) for many years, therefore, I should be able to tolerate the schedule albeit at a reduced level. Firstly, I created two mesocycles outlining my training programme (see appendix 1) <sup>88</sup>

## **Performing and Recording**

### **Pre-development test results**

Four simple hop tests have been selected to measure my physical progress because Braegelmann et al. (2011) say that many physiotherapists use these as a reliable method to measure knee function post ACL surgery. The main purpose of the hop tests are to try and measure the effectiveness of proprioceptive training after ACL surgery, as it improves coordination and neural activation of muscles. To measure this I will perform two different tests; triple hop<sup>5</sup> and single hop<sup>6</sup> test. The triple hop test consists of standing still on one leg on a spot and doing three jumps as far as you can, whereas the single hop test involves only one jump from a static position. <sup>74</sup>

Furthermore, Reid et al. (n.d) In Braegelmann et al. (2011) state that the hop tests are considered a reliable and valid outcome measure during rehabilitation after an ACL reconstruction. However, to ensure maximal reliability I followed Liu's (1994) protocol as closely as possible this included: securing the tape measure to the floor; a suitable warm up including two practice jumps each separated by 30 secs; a further 60 secs were given before the actual measured jump was performed; a training partner monitored that my starting position of the front foot was behind the zero mark; an additional 30 seconds rest was given after each jump; finally the non injured leg was always tested first. <sup>103</sup>

<sup>1227</sup>

pre- DP	my scores
squat	66.7kg
power clean	40 kg

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<sup>5</sup> triple hop - consists of standing on one leg and performing 3 consecutive hops

<sup>6</sup> Single hop - one jump from a static position



	triple hop test	single hop test
injured leg	4,20	1,10
non-injured leg	4,65	1,23
Limb symmetry index (LSI) <sup>7</sup>	0.903%	0.894%

	30m sprint test	30m sprint hurdle reduced height (74cm) test	100m sprint hurdle test reduced height (74cm)
<b>Times</b>	5.2	6.4	Unable to complete

## **INDIVIDUAL TRAINING SESSIONS**

### **Week 1**

#### **MONDAY**

Exercises	Exercises	Reps	Set s	Intensi ty	Speed of movem ent	Distan ce/tim e	Trainin g load	Recovery
<b>Warm-up</b>	Jog			light-m oderate	slow	20mins		None - straight into dynamic stretches
<b>Running technique/w arm-up progression (dynamic stretches)</b>	Skipping	2	1	light-m oderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	High knees	2	1	modera te	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	side-steps	2	1	modera te	slow - medium	25m per rep	body weight	Active recovery - jog

<sup>7</sup> The Limb Symmetry Index formula is used as a measure to see the suitability to return to competitive sport. LSI = injured limb / non-injured limb

								back 25m between reps
	Heel flicks	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
Weight training circuit (see appendix 1 for diagrams of each exercise)	Tricep extension	15	1	moderate	Fast	n/a	10kg	All 3 exercises performed one after the other (no rest)
	Russian twist	15	1	moderate	Fast	n/a	10kg	
	Squats	15	1	moderate	fast	n/a	10kg	
	Crunches	30	1	moderate	controlled	n/a	b/w	This is the rest exercise between the 3 exercises
	lateral steps	15	1	moderate	fast	n/a	10kg	no rest
	frontal steps	15	1	moderate	fast	n/a	10kg	no rest
	straight legs and bending the core towards the floor	15	1	moderate	fast	n/a	10kg	no rest
	lumber exercise	30	1	moderate	controlled	n/a	b/w	this is the rest exercise between the 3 exercises
	squats with one foot in front of the other	15	1	moderate	fast	n/a	10kg	no rest
	squat position is maintained while a weight is held out in front and moved laterally from side to side	15	1	moderate	fast	n/a	10kg	no rest

	crunches	30	1	moderate	controlled	n/a	b/w	this is the rest exercise between the 3 exercises
Fartlek training	Running on the track	1	1	varied	varied	distance depends on time	3 mins slow, 2 mins fast, 1 min top speed	5 mins rest after completion.  Then the weight circuit is completed again. (2 circuits in total)
Speed training (but constant speed - not explosive top speed)	sprints	10	1	moderate	moderate	100m	body weight	walk back 100m and repeat
Cool down	Gentle jog			low	low	800m	body weight	

## Tuesday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
Warm-up	Jog			light-moderate	slow	20mins		None - straight into dynamic stretches
Running technique/warm-up progression (dynamic stretches)	Skipping	2	1	light-moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	High knees	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps

	side-steps	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	Heel flicks	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
Interval training	sprints	12	1	moderate (70% Max speed)	moderate	80m	body weight	walk back 80m and repeat
Cool down	Gentle jog			low	low	800m	body weight	

### Wednesday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>Warm-up</b>	Jog + hurdles			light-moderate	slow	20mins (10mins with hurdles each 100m)		None - straight into dynamic stretches
<b>hurdle technique/mobility</b>	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm	2	1	moderate	fast	6	body	Active

				te		hurdles close together	weight	recovery - jog back
	74cm	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
<b>Running technique</b>	skipping	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	high knees	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	side-steps	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	heel flicks	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
Power training (jumps landing on sand pitch)	horizontal jumps	8	3	high	fast		body weight	walk back recovery (2 minutes recovery between sets)
Interval training	sprints	10	1	high (90%)	fast	100m	body weight	active recovery- jog back 100m
Cool down	Gentle jog & static stretches name the stretches hold for 30 seconds			low	low	800m	body weight	

### **Thursday**

<b>Exercises</b>	<b>Exercises</b>	<b>Reps</b>	<b>Sets</b>	<b>Intensity</b>	<b>Speed of</b>	<b>Distance/time</b>	<b>Training load</b>	<b>Recovery</b>
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					<b>movement</b>			
<b>Gym: arm test</b>	pectoral test	1	1	high	moderate		max. you can lift	None
<b>hurdle technique/mobility</b>	74cm (hurdle height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	?	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
<b>interval training; hurdles</b>	going over hurdles	5	1	high	fast	3 hurdles :35m	body weight	2 mins
<b>interval training; velocity/high-intensity</b>	sprints	2	1	high	fast	20m	body weight	3mins
		2	1	high	fast	30m	body weight	3mins
		2	1	high	fast	40m	body weight	3mins
<b>fartlek training</b>	running on the	1	1	varied	varied	25 mins	body weight	10 mins

	track							
<b>high intensity interval training</b>	running on the track	2 (one going up and one going down starting with 300m speed)	1	moderate	moderate	100m speed + 100m jog + 150m speed + 100m jog + 200m speed + 100m jog + 250m + 100m jog + 300m speed + 100m jog	body weight	none

### **Friday**

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>fartlek training / warm up</b>	Jog	1	1	varied	moderate	30 mins (3mins fast+3 mins low)	body weight	
<b>strength training/ gym</b>	½ squat	10	2	moderate	medium - fast		50kg	Active recovery - crunches
	hamstrings	10	2	moderate	medium - fast		15kg	Active recovery - lumbar
	power clean	10	2	moderate	medium - fast		30kg	Active recovery - crunches
	gastrocnemius	20	2	moderate	medium - fast		80kg	Active recovery - crunches

<b>interval training</b>	sprints/progressive running	10	1	moderate	Fast	60m	body weight	active recovery - jogging back 60m
<b>Cool down</b>	Gentle jog & static stretches name the stretches hold for 30 seconds			low	low	800m	body weight	

## **Week 2**

### **MONDAY**

<b>Exercises</b>	<b>Exercises</b>	<b>Reps</b>	<b>Sets</b>	<b>Intensity</b>	<b>Speed of movement</b>	<b>Distance/time</b>	<b>Training load</b>	<b>Recovery</b>
<b>Warm-up</b>	Jog			light-moderate	slow	20mins		None - straight into dynamic stretches
<b>Running technique/warm-up progression (dynamic stretches)</b>	Skipping	2	1	light-moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	High knees	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	side-steps	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	Heel flicks	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
<b>Weight training circuit</b>	Tricep extension	15	1	moderate	Fast	n/a	11kg	All 3 exercises performed one after the
	Russian twist	15	1	moderate	Fast	n/a	11kg	

				te				other (no rest)
	Squats	15	1	moderate	fast	n/a	12kg	
	Crunches	30	1	moderate	controlled	n/a	b/w +5kg	This is the rest exercise between the 3 exercises
	lateral steps	15	1	moderate	fast	n/a	11kg	no rest
	frontal steps	15	1	moderate	fast	n/a	11kg	no rest
	straight legs and bending the core towards the floor	15	1	moderate	fast	n/a	11kg	no rest
	lumber exercise (superman!)	30	1	moderate	controlled	n/a	b/w	this is the rest exercise between the 3 exercises
	squats with one foot in front of the other (lunges)	15	1	moderate	fast	n/a	12kg	no rest
	squat position is maintained while a weight is held out in front and moved laterally from side to side	15	1	moderate	fast	n/a	11kg	no rest
	crunches	30	1	moderate	controlled	n/a	b/w	this is the rest exercise between the 3 exercises
Fartlek training	Running on the track	1	1	varied	varied	distance depends on time	3 mins slow, 2 mins fast, 1 min top speed	5 mins rest after completion.  Then the weight circuit

								is completed again. (2 circuits in total)
Speed training (but constant speed - not explosive top speed)	sprints	10	1	moderate	moderate	100m	body weight	walk back 100m and repeat
Cool down	Gentle jog			low	low	800m	body weight	

## Tuesday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
Warm-up	Jog			light-moderate	slow	20mins		None - straight into dynamic stretches
Running technique/warm-up progression (dynamic stretches)	Skipping	2	1	light-moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	High knees	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	side-steps	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	Heel flicks	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps



Interval training	sprints	12	1	moderate (75% Max speed)	moderate	80m	body weight	walk back 80m and repeat
Cool down	Gentle jog			low	low	800m	body weight	

### Wednesday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
Warm-up	Jog + hurdles			light-moderate	slow	20mins (10mins with hurdles each 100m)		None - straight into dynamic stretches
hurdle technique/mobility	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
Running	skipping	2	1	light-m	fast	25m	body	active

technique				oderate		per rep	weight	recovery- jog back
	high knees	2	1	light-m oderate	fast	25m per rep	body weight	active recovery- jog back
	side-steps	2	1	light-m oderate	fast	25m per rep	body weight	active recovery- jog back
	heel flicks	2	1	light-m oderate	fast	25m per rep	body weight	active recovery- jog back
Power training (jumps landing on sand pitch)	horizontal jumps	8	4 (unc hang ed)	high	fast		body weight	walk back recovery (2 minutes recovery between sets)
Interval training	sprints	10	1	high (90%)	fast	100m	body weight	active recovery- jog back 100m
Cool down	Gentle jog & static stretches name the stretches hold for 30 seconds			low	low	800m	body weight	

### Thursday

Exercises	Exercis es	Reps	Sets	Intensi ty	Speed of movem ent	Distan ce/time	Trainin g load	Recovery
Gym: arm test	pectoral test	1	1	high	moderate		max. you can lift	None
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close togethe	body weight	Active recovery - jog back

<b>hurdle technique/mobility</b>						r		
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
<b>interval training; hurdles</b>	going over hurdles	5	1	high	fast	3 hurdles :35m	body weight	2 mins
<b>interval training; velocity/high-intensity</b>	sprints	3	1	high	fast	20m	body weight	3mins
		2	1	high	fast	30m	body weight	3mins
		2	1	high	fast	40m	body weight	3mins
<b>fartlek training</b>	running on the track	1	1	varied	varied	25 mins	body weight	10 mins
<b>high intensity interval training</b>	running on the track	2 (one going up and one going down starting with 300m speed)	1	moderate	moderate	100m speed + 100m jog + 150m speed + 100m jog + 200m speed	body weight	none

						+ 100m jog + 250m + 100m jog + 300m speed + 100m jog		
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### Friday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>fartlek training / warm up</b>	Jog	1	1	varied	moderate	30 mins (3mins fast+3 mins low)	body weight	
<b>strength training/ gym</b>	½ squat	10	2	moderate	medium - fast		50kg	Active recovery - crunches
	hamstrings	10	2	moderate	medium - fast		15kg	Active recovery - lumbar
	power clean	10	2	moderate	medium -fast		30kg	Active recovery - crunches
	gastrocnemius	20	2	moderate	medium -fast		80kg	Active recovery - crunches
<b>interval training</b>	sprints/progressive running	10	1	moderate	Fast	60m	body weight	active recovery - jogging back 60m
<b>Cool down</b>	Gentle jog & static stretches name the stretches hold for 30			low	low	800m	body weight	

	seconds							
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### Week 3

### MONDAY

Exercises	Exercises	Reps	Set s	Intensi ty	Speed of movem ent	Distan ce/tim e	Trainin g load	Recovery
Warm-up	Jog			light-m oderate	slow	20mins		None - straight into dynamic stretches
Running technique/w arm-up progression (dynamic stretches)	Skipping	2	1	light-m oderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	High knees	2	1	modera te	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	side-steps	2	1	modera te	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	Heel flicks	2	1	modera te	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
Weight training circuit	Tricep extension	15	1	modera te	Fast	n/a	12kg	All 3 exercises performed one after the other (no rest)
	Russian twist	15	1	modera te	Fast	n/a	12kg	
	Squats	15	1	modera te	fast	n/a	14kg	
	Crunches	30	1	modera te	controll ed	n/a	b/w +5kg	This is the rest exercise between the 3 exercises



	lateral steps	15	1	moderate	fast	n/a	12kg	no rest
	frontal steps	15	1	moderate	fast	n/a	12kg	no rest
	straight legs and bending the core towards the floor	15	1	moderate	fast	n/a	12kg	no rest
	lumber exercise	30	1	moderate	controlled	n/a	b/w	this is the rest exercise between the 3 exercises
	squats with one foot in front of the other	15	1	moderate	fast	n/a	14kg	no rest
	squat position is maintained while a weight is held out in front and moved laterally from side to side	15	1	moderate	fast	n/a	12kg	no rest
	crunches	30	1	moderate	controlled	n/a	b/w	this is the rest exercise between the 3 exercises
Fartlek training	Running on the track	1	1	varied	varied	distance depends on time	3 mins slow, 2 mins fast, 1 min top speed	5 mins rest after completion.  Then the weight circuit is completed again. (2 circuits in total)
Speed training (but constant speed - not explosive top speed)	sprints	10	1	moderate	moderate	100m	body weight	walk back 100m and repeat

Cool down	Gentle jog			low	low	800m	body weight	
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## Tuesday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
Warm-up	Jog			light-moderate	slow	20mins		None - straight into dynamic stretches
Running technique/warm-up progression (dynamic stretches)	Skipping	2	1	light-moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	High knees	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	side-steps	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	Heel flicks	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
Interval training	sprints	12	1	moderate (80% Max speed)	moderate	80m	body weight	walk back 80m and repeat
Cool down	Gentle jog			low	low	800m	body weight	

**Wednesday**

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>Warm-up</b>	Jog + hurdles			light-moderate	slow	20mins (10mins with hurdles each 100m)		None - straight into dynamic stretches
<b>hurdle technique/mobility</b>	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
<b>Running technique</b>	skipping	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	high knees	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	side-steps	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back

	heel flicks	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
Power training (jumps landing on sand pitch)	horizontal jumps	8	4	high	fast		body weight	walk back recovery (2 minutes recovery between sets)
Interval training	sprints	10	1	high (90%)	fast	100m	body weight	active recovery- jog back 100m
Cool down	Gentle jog & static stretches name the stretches hold for 30 seconds			low	low	800m	body weight	

#### Thursday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
Gym: arm test	pectoral test	1	1	high	moderate		max. you can lift	None
hurdle technique/mobility	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close	body weight	Active recovery - jog back

	height)					together		
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
<b>interval training; hurdles</b>	going over hurdles	5	1	high	fast	3 hurdles :35m	body weight	2 mins
<b>interval training; velocity/ high-intensity</b>	sprints	3 (unchanged)	1	high	fast	20m	body weight	3mins
		2	1	high	fast	30m	body weight	3mins
		2	1	high	fast	40m	body weight	3mins
<b>fartlek training</b>	running on the track	1	1	varied	varied	25 mins	body weight	10 mins
<b>high intensity interval training</b>	running on the track	2 (one going up and one going down starting with 300m speed)	1	moderate	moderate	100m speed + 100m jog + 150m speed + 100m jog + 200m speed + 100m jog + 250m + 100m jog + 300m speed + 100m jog	body weight	none



**Friday**

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>fartlek training / warm up</b>	Jog	1	1	varied	moderate	30 mins (3mins fast+3 mins low)	body weight	
<b>strength training/ gym</b>	½ squat	12	2	moderate	medium - fast		50kg	Active recovery - crunches
	hamstrings	12	2	moderate	medium - fast		15kg	Active recovery - lumbar
	power clean	12	2	moderate	medium -fast		30kg	Active recovery - crunches
	gastrocnemius	20	2	moderate	medium -fast		82.5kg	Active recovery - crunches
<b>interval training</b>	sprints/progressive running	10	1	moderate	Fast	60m	body weight	active recovery - jogging back 60m
<b>Cool down</b>	Gentle jog & static stretches name the stretches hold for 30 seconds			low	low	800m	body weight	

**Week 4****MONDAY**

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
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Warm-up	Jog			light-moderate	slow	20mins		None - straight into dynamic stretches
Running technique/warm-up progression (dynamic stretches)	Skipping	2	1	light-moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	High knees	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	side-steps	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	Heel flicks	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
Weight training circuit	Tricep extension	17	1	moderate	Fast	n/a	12kg	All 3 exercises performed one after the other (no rest)
	Russian twist	17	1	moderate	Fast	n/a	12kg	
	Squats	17	1	moderate	fast	n/a	14kg	
	Crunches	30	1	moderate	controlled	n/a	b/w +7kg	This is the rest exercise between the 3 exercises
	lateral steps	17	1	moderate	fast	n/a	12kg	no rest
	frontal steps	17	1	moderate	fast	n/a	12kg	no rest
	straight legs and bending the core towards the floor	15	1	moderate	fast	n/a	12kg	no rest

	lumber exercise	30	1	moderate	controlled	n/a	b/w	this is the rest exercise between the 3 exercises
	squats with one foot in front of the other	17	1	moderate	fast	n/a	14kg	no rest
	squat position is maintained while a weight is held out in front and moved laterally from side to side	17	1	moderate	fast	n/a	12kg	no rest
	crunches	30	1	moderate	controlled	n/a	b/w	this is the rest exercise between the 3 exercises
Fartlek training	Running on the track	1	1	varied	varied	distance depends on time	3 mins slow, 2 mins fast, 1 min top speed	5 mins rest after completion.  Then the weight circuit is completed again. (2 circuits in total)
Speed training (but constant speed - not explosive top speed)	sprints	10	1	moderate	moderate	100m	body weight	walk back 100m and repeat
Cool down	Gentle jog			low	low	800m	body weight	

### Tuesday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
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<b>Warm-up</b>	Jog			light-moderate	slow	20mins		None - straight into dynamic stretches
<b>Running technique/warm-up progression (dynamic stretches)</b>	Skipping	2	1	light-moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	High knees	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	side-steps	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	Heel flicks	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
Interval training	sprints	12	1	moderate (80% Max speed)	moderate	80m	body weight	walk back 80m and repeat
Cool down	Gentle jog			low	low	800m	body weight	

### Wednesday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>Warm-up</b>	Jog + hurdles			light-moderate	slow	20mins (10mins with hurdles each)		None - straight into dynamic stretches

						100m)		
<b>hurdle technique/mobility</b>	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
<b>Running technique</b>	skipping	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	high knees	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	side-steps	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	heel flicks	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
<b>Power training (jumps landing on sand pitch)</b>	horizontal jumps	10	4	high	fast		body weight	walk back recovery (2 minutes recovery between sets)
<b>Interval</b>	sprints	10	1	high	fast	100m	body	active

training				(90%)			weight	recovery- jog back 100m
Cool down	Gentle jog & static stretches name the stretches hold for 30 seconds			low	low	800m	body weight	

### Thursday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
Gym: arm test	pectoral test	1	1	high	moderate		max. you can lift	None
hurdle technique/mobility	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
interval training; hurdles	going over hurdles	5	1	high	fast	3 hurdles (total)	body weight	2 mins



						distance 35m)		
<b>interval training; velocity/ high-intensity</b>	sprints	3	1	high	fast	20m	body weight	3mins
		2	1	high	fast	30m	body weight	3mins
		2	1	high	fast	40m	body weight	3mins
<b>fartlek training</b>	running on the track	1	1	varied	varied	25 mins	body weight	10 mins
<b>high intensity interval training</b>	running on the track	2 (one going up and one going down starting with 300m speed)	1	moderate	moderate	100m speed + 100m jog + 150m speed + 100m jog + 200m speed + 100m jog + 250m + 100m jog + 300m speed + 100m jog	body weight	none

### Friday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
	Jog	1	1	varied	moderate	30 mins (3mins	body weight	

<b>fartlek training / warm up</b>						fast+3 mins low)		
<b>strength training/ gym</b>	½ squat	10	2	moderate	medium - fast		52.5kg	Active recovery - crunches
	hamstrings	10	2	moderate	medium - fast		16.25kg	Active recovery - lumbar
	power clean	10	2	moderate	medium -fast		32kg	Active recovery - crunches
	gastrocnemius	20	2	moderate	medium -fast		85kg	Active recovery - crunches
<b>interval training</b>	sprints/progressive running	10	1	moderate	Fast	60m	body weight	active recovery - jogging back 60m
<b>Cool down</b>	Gentle jog & static stretches name the stretches hold for 30 seconds			low	low	800m	body weight	

### Week 5

### MONDAY

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>Warm-up</b>	Jog			light-moderate	slow	20mins		None - straight into dynamic stretches
	Skipping	2	1	light-moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps

Running technique/w arm-up progression (dynamic stretches)	High knees	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	side-steps	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	Heel flicks	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
Weight training circuit	Tricep extension	17	1	moderate	Fast	n/a	12kg	All 3 exercises performed one after the other (no rest)
	Russian twist	17	1	moderate	Fast	n/a	12kg	
	Squats	17	1	moderate	fast	n/a	12kg	
	Crunches	30	1	moderate	controlled	n/a	b/w +7kg	This is the rest exercise between the 3 exercises
	lateral steps	17	1	moderate	fast	n/a	12kg	no rest
	frontal steps	17	1	moderate	fast	n/a	12kg	no rest
	straight legs and bending the core towards the floor	17	1	moderate	fast	n/a	12kg	no rest
	lumber exercise	30	1	moderate	controlled	n/a	b/w	this is the rest exercise between the 3 exercises
	squats with one foot in front of the other	17	1	moderate	fast	n/a	14kg	no rest
	squat position is maintained	17	1	moderate	fast	n/a	12kg	no rest

	while a weight is held out in front and moved laterally from side to side							
	crunches	30	1	moderate	controlled	n/a	b/w	this is the rest exercise between the 3 exercises
Fartlek training	Running on the track	1	1	varied	varied	distance depends on time	3 mins slow, 2 mins fast, 1 min top speed	5 mins rest after completion.  Then the weight circuit is completed again. (2 circuits in total)
Speed training (but constant speed - not explosive top speed)	sprints	12	1	moderate	moderate	100m	body weight	walk back 100m and repeat
Cool down	Gentle jog			low	low	800m	body weight	

## Tuesday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
Warm-up	Jog			light-moderate	slow	20mins		None - straight into dynamic stretches
	Skiping	2	1	light-moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m

<b>Running technique/warm-up progression (dynamic stretches)</b>								between reps
	High knees	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	side-steps	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
	Heel flicks	2	1	moderate	slow - medium	25m per rep	body weight	Active recovery - jog back 25m between reps
Interval training	sprints	12	1	moderate (85% Max speed)	moderate	80m	body weight	walk back 80m and repeat
Cool down	Gentle jog			low	low	800m	body weight	

### Wednesday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>Warm-up</b>	Jog + hurdles			light-moderate	slow	20mins (10mins with hurdles each 100m)		None - straight into dynamic stretches
<b>hurdle technique/m</b>	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back

obility	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
Running technique	skipping	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	high knees	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	side-steps	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
	heel flicks	2	1	light-moderate	fast	25m per rep	body weight	active recovery- jog back
Power training (jumps landing on sand pitch)	horizontal jumps	10	4	high	fast		body weight	walk back recovery (2 minutes recovery between sets)
Interval training	sprints	10	1	high (90%)	fast	100m	body weight	active recovery- jog back 100m
Cool down	Gentle jog & static stretches name the stretches hold for 30 seconds			low	low	800m	body weight	

**Thursday**

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>Gym: arm test</b>	pectoral test	1	1	high	moderate		max. you can lift	None
<b>hurdle technique/mobility</b>	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
	74cm hurdles (reduced height)	2	1	moderate	fast	6 hurdles close together	body weight	Active recovery - jog back
<b>interval training; hurdles</b>	going over hurdles	5	1	high	fast	3 hurdles (total distance 35m)	body weight	2 mins
<b>interval training; velocity/high-intensity</b>	sprints	3	1	high	fast	20m	body weight	3mins



		3	1	high	fast	30m	body weight	3mins
		3	1	high	fast	40m	body weight	3mins
<b>fartlek training</b>	running on the track	1	1	varied	varied	25 mins	body weight	10 mins
<b>high intensity interval training</b>	running on the track	2 (one going up and one going down starting with 300m speed)	1	moderate	moderate	100m speed + 100m jog + 150m speed + 100m jog + 200m speed + 100m jog + 250m + 100m jog + 300m speed + 100m jog	body weight	none

### Friday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>fartlek training / warm up</b>	Jog	1	1	varied	moderate	30 mins (3mins fast+3 mins low)	body weight	
<b>strength training/</b>	½ squat	10	2	moderate	medium - fast		52.5k	Active recovery - crunches
	hamstrings	10	2	moderate	medium - fast		16.25kg	Active recovery -

gym								lumbars
	power clean	10	2	moderate	medium-fast		32kg	Active recovery - crunches
	gastrocnemius	20	2	moderate	medium-fast		85kg	Active recovery - crunches
interval training	sprints/progressive running	10	1	moderate	Fast	60m	body weight	active recovery - jogging back 60m
Cool down	Gentle jog & static stretches name the stretches hold for 30 seconds			low	low	800m	body weight	

#### Mid-development Plan fitness test scores

	triple hop test	single hop test
injured leg	4,29	1,15
non-injured leg	4,68	1,28
Limb symmetry index	0.916%	0.898%

	30m sprint test	30m sprint hurdle reduced height (74cm) test	100m sprint hurdle test
Times	5.0	6.1	Unable to complete

	mid
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squat	75kg
power clean	45kg

### **Start of mesocycle 2**

*Second mesocycle - 5 weeks*

monday	tuesday	wednesday	thursday	friday	saturday	sunday
.15 min jogg .proprioception .Acceleration technique .5x20 recovery:1'30 min / pause 6 min Plyometrics (vertical jumps) .2(5x20m) recovery 20 sec +400m pause 6 min	Rest day	.Gym (upper body) .Rhythmic model over hurdles (80m r' walking back) .5x(40 max. speed + 40 submax) recover 3mins  .Max= amplitude running .submax=frequency running	15'min jogg .proprioceptive training .multi horizontal and vertical jumps .using sleds 7'5kg, acceleration technique over 50m  2x(3x200+500) 1min recovery in between 200 and 500, and 4mins pause in between blocks.	.Gym .5x(40 submax+40 max) .5x50 triple jumps .2x(5x20) recover :1min pause: 6 min .10'min jogg	rest day	rest day

### **Week 6**

#### **Monday**

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
warm up as above in previous training sessions								
proprioceptive training	BOSU (1 legged squat)	6	3	high	controlled		Start with b/w	2 min

	BOSU (standing on 1 leg )	8	3	high	controlled		n/a	2mins
	wobble board + elastic band (one leg in contact with the wobble board)	4	5	high	controlled		n/a	2 mins
	1 legged Bulgarian split squats	8	3	high	controlled		n/a	2 mins
	reverse bosu-2 legs squat	10	4	high	controlled		n/a	2 mins
	2 BOSU alternating 1 legged jumps	8	3	high	controlled		n/a	2 mins
	swiss ball	8	4	high	controlled		n/a	2 mins
<b>plyometrics training</b>	multi vertical jumps	6	4	high	fast		n/a	2 mins
<b>speed training/ speed endurance</b>	acceleration technique	5	1	high	fast	20m	n/a	1 min between 20m
		5	2	moderate  400m Moderate	moderate	20m  1x400 (80% of max)	n/a	20secs between each 20m  6mins between each set
<b>cool down as above in previous training sessions</b>								

**Wednesday**

Exercise	Exercise	Reps	sets	intensity	speed of movement	distance/time	training load	recovery
<b>gym</b>	bench press	8	3	80%	controlled		20kg	abs/lower back 30 reps
	Seated cable row	8	3	80%	controlled		25kg	abs/lower back 30 reps
	military press	8	3	60%	high		18kg	abs/lower back 30 reps
<b>interval training</b>	Rhythmic model over hurdles	5	1	moderate	moderate	80m		walking back (80m)
	speed (amplitude)	4	5	moderate	moderate	40m		3mins
	speed (frequency)	4	5	moderate	fast	40m		3mins

### Thursday

exercices	exercise	reps	sets	intensity	speed of movement	distance/time	body weight	recovery
<b>Warm up as above in previous sessions</b>								
<b>proprioceptive training</b>	BOSU (1 legged squat)	6	3	high	controlled		Start with b/w	2 min
	BOSU (standing on 1 leg )	8	3	high	controlled		n/a	2mins
	wobble board + elastic band (one leg in contact with the wobble board)	4	5	high	controlled		n/a	2 mins

	1 legged Bulgarian split squats	8	3	high	controlled		n/a	2 mins
	reverse bosu- 2 legs squat	10	4	high	controlled		n/a	2 mins
	2 BOSU alternating 1 legged jumps	8	3	high	controlled		n/a	2 mins
	swiss ball	8	4	high	controlled		n/a	2 mins
Plyometric training	horizontal jumps	1	3	high	controlled	60m (continuous jumps over 60m)	n/a	2 mins
	vertical jumps (hurdles)	1	3	high	controlled	5 hurdles	n/a	2 mins
assisted training	sleds	5	1	high	moderate	50m	5 kg	2 mins
interval	see below							

2x(3x200+500) 1min recovery in between 200 and 500, and 4mins pause in between blocks.

### Friday

exercices	exercise	reps	sets	intensity	speed of movement	distance/time	body weight	recovery
interval training	speed (amplitude)	4	5	moderate	moderate	40m		3mins

	speed (frequency)	4	5	moderate	fast	40m		3mins
<b>plyometrics</b>	triple jumps	5	1	moderate	controlled	50m		2 mins
<b>interval</b>	speed	5	2	high	high	20m		1 min 6 min between sets
<b>cool down</b>	jog	1	1	low	controlled	10mins		

### Week 7

Monday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
warm up as above in previous training sessions								
<b>proprioceptive training</b>	BOSU (1 legged squat)	6	3	high	controlled		medicine ball (2kg)	2 min
	BOSU (standing on 1 leg )	9	3	high	controlled		n/a	2mins
	wobble board + elastic band (one leg in contact with the wobble board)	5	5	high	controlled		n/a	2 mins
	1 legged Bulgarian split squats	9	3	high	controlled		n/a	2 mins



	reverse bosu-2 legs squat	11	4	high	controlled		n/a	2 mins
	2 BOSU alternating 1 legged jumps	9	3	high	controlled		n/a	2 mins
	swiss ball	9	4	high	controlled		n/a	2 mins
<b>plyometrics training</b>	multi vertical jumps	7	4	high	fast		n/a	2 mins
<b>speed training/ speed endurance</b>	acceleration technique	5	1	high	fast	20m	n/a	1 min between 20m
		5	2	moderate  400m Moderate	moderate	20m  1x400 (80% of max)	n/a	20secs between each 20m  6mins between each set
<b>cool down as above in previous training sessions</b>								

### Wednesday

Exercise	Exercise	Reps	sets	intensity	speed of movement	distance/time	training load	recovery
<b>gym</b>	Bench press	10	3	80%	controlled		20kg	abs/lower back 30 reps
	Seated cable row	10	3	80%	controlled		25kg	abs/lower back 30 reps
	military press	10	3	60%	high		18kg	abs/lower back 30 reps
<b>interval training</b>	Rhythmic model over hurdles	5	1	moderate	moderate	80m		walking back (80m)

	speed (amplitude)	4	5	moderate	moderate	40m		3mins
	speed (frequency)	4	5	moderate	fast	40m		3mins

### Thursday

exercices	exercise	reps	sets	intensity	speed of movement	distance/time	body weight	recovery
Warm up as above in previous sessions								
proprioceptive training	BOSU (1 legged squat)	6	3	high	controlled		medicine ball (2kg)	2 min
	BOSU (standing on 1 leg )	9	3	high	controlled		n/a	2mins
	wobble board + elastic band (one leg in contact with the wobble board)	5	5	high	controlled		n/a	2 mins
	1 legged Bulgarian split squats	9	3	high	controlled		n/a	2 mins
	reverse bosu- 2 legs squat	11	4	high	controlled		n/a	2 mins
	2 BOSU alternating 1 legged jumps	9	3	high	controlled		n/a	2 mins

	swiss ball	9	4	high	controlled		n/a	2 mins
Plyometric training	horizontal jumps	1	3	high	controlled	60m	n/a	2 mins
	vertical jumps (hurdles)	1	3	high	controlled	5 hurdles	n/a	2 mins
assisted training	sleds	5	1	high	moderate	50m	5 kg	2 mins
interval								

2x(3x200+500) 1min recovery in between 200 and 500. and 4mins pause in between blocks

### **Friday**

exercices	exercise	reps	sets	intensity	speed of movement	distance/time	body weight	recovery
interval training	speed (amplitude)	5	5	moderate	moderate	40m		3mins
	speed (frequency)	4	5	moderate	fast	40m		3mins
plyometrics	triple jumps	5	1	moderate	controlled	50m		2 mins
interval	speed	6	2	high	high	20m		1 min 6 min between sets
cool down	jog	1	1	low	controlled	10 mins		

### **Week 8** **Monday**

Exercises	Exercises	Rep s	Sets	Intensi ty	Speed of movem ent	Dista nce/t ime	Training load	Recover y
warm up as above in previous training sessions								
propriocepti ve training	BOSU (1 legged squat)	8	3	high	controll ed		medicine ball (2kg)	2 min
	BOSU (standing on 1 leg )	10	3	high	controll ed		n/a	2mins
	wobble board + elastic band (one leg in contact with the wobble board)	6	5	high	controll ed		n/a	2 mins
	1 legged Bulgarian split squats	10	3	high	controll ed		n/a	2 mins
	reverse bosu- 2 legs squat	12	4	high	controll ed		n/a	2 mins
	2 BOSU alternating 1 legged jumps	10	3	high	controll ed		n/a	2 mins
	swiss ball	10	4	high	controll ed		n/a	2 mins
plyometrics training	multi vertical jumps	8	4	high	fast		n/a	2 mins
speed training/ speed endurance	acceleration technique	6	1	high	fast	20m	n/a	1 min between 20m
		6	2	modera	moderat	20m	n/a	20secs

				te 400m Modera te	e	1x40 0 (80% of max)		between each 20m  6mins between each set
cool down as above in previous training sessions								

### Wednesday

Exercise	Exercise	Rep s	sets	intensity	speed of movement	distance/ti me	trainin g load	recovery
gym	Bench press	8	3	80%	controlled		22kg	abs/lower back 30 reps
	seated cable row	8	3	80%	controlled		27.5kg	abs/lower back 30 reps
	military press	8	3	60%	high		20kg	abs/lower back 30 reps
interval training	Rhythmic model over hurdles	6	1	moderate	moderate	80m		walking back (80m)
	speed (amplitude)	5	5	moderate	moderate	40m		3mins
	speed (frequency)	5	5	moderate	fast	40m		3mins

### Thursday

exercices	exercise	reps	sets	intensity	speed of movement	distance/time	body weight	recovery
Warm up as above in previous sessions								

proprioceptive training	BOSU (1 legged squat)	6	3	high	controlled		medicine ball (3kg)	2 min
	BOSU (standing on 1 leg )	10	3	high	controlled		n/a	2mins
	wobble board + elastic band (one leg in contact with the wobble board)	6	5	high	controlled		n/a	2 mins
	1 legged Bulgarian split squats	10	3	high	controlled		n/a	2 mins
	reverse bosu- 2 legs squat	12	4	high	controlled		n/a	2 mins
	2 BOSU alternating 1 legged jumps	10	3	high	controlled		n/a	2 mins
	swiss ball	10	4	high	controlled		n/a	2 mins
Plyometric training	horizontal jumps	2	3	high	controlled	60m	n/a	2 mins
	vertical jumps (hurdles)	2	3	high	controlled	5 hurdles	n/a	2 mins
assisted training	sleds	5	1	high	moderate	50m	10 kg	2 mins
interval								

2x(4x200+500) 1min recovery in between 200 and 500, and 4mins pause in between

blocks

Friday

exercices	exercise	reps	sets	intensity	speed of movement	distance/time	body weight	recovery
<b>gym</b>								
<b>interval training</b>	speed (amplitude)	5	5	moderate	moderate	40m		3mins
	speed (frequency)	5	5	moderate	fast	40m		3mins
<b>plyometrics</b>	triple jumps	5	1	moderate	controlled	50m		2 mins
<b>interval</b>	speed	6	2	high	high	20m		1 min 6 min between sets
<b>cool down</b>	jog	1	1	low	controlled	10min		

Week 9

Monday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
<b>warm up as above in previous training sessions</b>								
<b>proprioceptive training</b>	BOSU (1 legged squat)	6	3	high	controlled		medicine ball (3kg)	2 min
	BOSU	10	3	high	controlled		n/a	2mins



	(standing on 1 leg )				ed			
	wobble board + elastic band (one leg in contact with the wobble board)	6	5	high	controlled		n/a	2 mins
	1 legged Bulgarian split squats	10	3	high	controlled		n/a	2 mins
	reverse bosu- 2 legs squat	12	4	high	controlled		n/a	2 mins
	2 BOSU alternating 1 legged jumps	10	3	high	controlled		n/a	2 mins
	swiss ball	10	4	high	controlled		n/a	2 mins
<b>plyometrics training</b>	multi vertical jumps	8	4	high	fast		n/a	2 mins
<b>speed training/ speed endurance</b>	acceleration technique	6	1	high	fast	20m	n/a	1 min between 20m
		6	2	moderate 400m Moderate	moderate	20m 1x400 (80% of max)	n/a	20secs between each 20m  6mins between each set
<b>cool down as above in previous training sessions</b>								

**Wednesday**

Exercise	Exercise	Reps	sets	intensity	speed of movement	distance/time	training load	recovery
<b>gym</b>	Bench press	8	3	80%	controlled		22kg	abs/lower back 30 reps
	seated cable row	8	3	80%	controlled		27.5kg	abs/lower back 30 reps
	military press	8	3	60%	high		20kg	abs/lower back 30 reps
<b>interval training</b>	Rhythmic model over hurdles	6	1	moderate	moderate	80m		walking back (80m)
	speed (amplitude)	5	5	moderate	moderate	40m		3mins
	speed (frequency)	5	5	moderate	fast	40m		3mins

#### Thursday

exercices	exercise	reps	sets	intensity	speed of movement	distance/time	body weight	recovery
<b>Warm up as above in previous sessions</b>								
<b>proprioceptive training</b>	BOSU (1 legged squat)	8	3	high	controlled		medicine ball (3kg)	2 min
	BOSU (standing on 1 leg )	11	3	high	controlled		n/a	2mins
	wobble board + elastic band (one leg in contact with the wobble board)	7	5	high	controlled		n/a	2 mins

	1 legged Bulgarian split squats	11	3	high	controlled		n/a	2 mins
	reverse bosu- 2 legs squat	13	4	high	controlled		n/a	2 mins
	2 BOSU alternating 1 legged jumps	11	3	high	controlled		n/a	2 mins
	swiss ball	11	4	high	controlled		n/a	2 mins
Plyometric training	horizontal jumps	2	3	high	controlled	60m	n/a	2 mins
	vertical jumps (hurdles)	2	3	high	controlled	5 hurdles	n/a	2 mins
assisted training	sleds	5	1	high	moderate	50m	10 kg	2 mins
interval								

2x(4x200+500) 1min recovery in between 200 and 500. and 4mins pause in between blocks.

### **Friday**

exercices	exercise	reps	sets	intensity	speed of movement	distance/time	body weight	recovery
interval training	speed (amplitude)	6	5	moderate	moderate	40m		3mins
	speed (frequency)	5	5	moderate	fast	40m		3mins

<b>plyometrics</b>	triple jumps	6	1	moderate	controlled	50m		2 mins
<b>interval</b>	speed	6	2	high	high	20m		1 min 6 min between sets
<b>cool down</b>	jog	1	1	low	controlled	10mins		

## Week 10

### Monday

Exercises	Exercises	Reps	Sets	Intensity	Speed of movement	Distance/time	Training load	Recovery
warm up as above in previous training sessions								
<b>proprioceptive training</b>	BOSU (1 legged squat)	8	3	high	controlled		medicine ball (3kg)	2 min
	BOSU (standing on 1 leg )	11	3	high	controlled		n/a	2mins
	wobble board + elastic band (one leg in contact with the wobble board)	7	5	high	controlled		n/a	2 mins
	1 legged Bulgarian split squats	11	3	high	controlled		n/a	2 mins
	reverse bosu- 2 legs squat	13	4	high	controlled		n/a	2 mins

	2 BOSU alternating 1 legged jumps	11	3	high	controlled		n/a	2 mins
	swiss ball	11	4	high	controlled		n/a	2 mins
<b>plyometrics training</b>	multi vertical jumps	9	4	high	fast		n/a	2 mins
<b>speed training/ speed endurance</b>	acceleration technique	6	1	high	fast	20m	n/a	1 min between 20m
		6	2	moderate  400m Moderate	moderate	20m  1x400 (80% of max)	n/a	20secs between each 20m  6mins between each set
<b>cool down as above in previous training sessions</b>								

### Wednesday

Exercise	Exercise	Reps	sets	intensity	speed of movement	distance/time	training load	recovery
<b>gym</b>	Bench press	8	3	80%	controlled		24kg	abs/lower back 30 reps
	seated cable row	8	3	80%	controlled		30kg	abs/lower back 30 reps
	military press	8	3	60%	high		22kg	abs/lower back 30 reps
<b>interval training</b>	Rhythmic model over hurdles	6	1	moderate	moderate	80m		walking back (80m)
	speed (amplitude)	5	5	moderate	moderate	40m		3mins

	speed (frequency)	5	5	moderate	fast	40m		3mins
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### Thursday

exercices	exercise	reps	sets	intensity	speed of movement	distance/time	body weight	recovery
Warm up as above in previous sessions								
proprioceptive training	BOSU (1 legged squat)	6	3	high	controlled		medicine ball (4kg)	2 min
	BOSU (standing on 1 leg )	11	3	high	controlled		n/a	2 mins
	wobble board + elastic band (one leg in contact with the wobble board)	7	5	high	controlled		n/a	2 mins
	1 legged Bulgarian split squats	11	3	high	controlled		n/a	2 mins
	reverse bosu- 2 legs squat	13	4	high	controlled		n/a	2 mins
	2 BOSU alternating 1 legged jumps	11	3	high	controlled		n/a	2 mins
	swiss ball	11	4	high	controlled		n/a	2 mins

Plyometric training	horizontal jumps	3	3	high	controlled	60m	n/a	2 mins
	vertical jumps (hurdles)	3	3	high	controlled	5 hurdles	n/a	2 mins
assisted training	sleds	5	1	high	moderate	50m	12 kg	2 mins
interval								

2x(5x200+500) 1min recovery in between 200 and 500. and 4mins pause in between blocks.

I tried to increase to 5 repetitions but I could not finish the final 500m in the last set!

### **Friday**

exercices	exercise	reps	sets	intensity	speed of movement	distance/time	body weight	recovery
interval training	speed (amplitude)	6	5	moderate	moderate	40m		3mins
	speed (frequency)	6	5	moderate	fast	40m		3mins
plyometrics	triple jumps	6	1	moderate	controlled	50m		2 mins
interval	speed	7	2	high	high	20m		1 min 6 min between sets
cool down	jog	1	1	low	controlled	10min		

### **Post development Plan scores**

	triple hop test	single hop test
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injured leg	4,34	1,18
non-injured leg	4,69	1,31
Limb symmetry index	0.925%	0.900%

	30m sprint test	30m sprint hurdle reduced height (74cm) test	100m sprint hurdle test
Times	4.8	6.0	Unable to complete

	post
squat	82kg
power clean	50kg

## Review and Evaluation

### Predevelopment test results

	triple hop test	single hop test
injured leg	4,20	1,10
non-injured leg	4,65	1,23
Limb symmetry index	0.903%	0.894%

	30m sprint test	30m sprint hurdle reduced height (74cm) test	100m sprint hurdle test reduced height (74cm)
Times	5.2	6.4	Unable to complete

### Mid-development test

	triple hop test	single hop test
injured leg	4,29	1,15
non-injured leg	4,68	1,28
Limb symmetry index	0.916%	0.898%

	30m sprint test	30m sprint hurdle reduced height (74cm) test	100m sprint hurdle test
Times	5.0	6.1	Unable to complete

### Post-development test results

	triple hop test	single hop test
injured leg	4,34	1,18
non-injured leg	4,69	1,31
Limb symmetry index	0.925%	0.900%

	30m sprint test	30m sprint hurdle reduced height (74cm) test	100m sprint hurdle test
Times	4.8	6.0	Unable to complete

	pre	mid	post
squat	66.7kg	75kg	82kg
power clean	40 kg	45kg	50kg

Firstly, I feel the progress I have made has been really positive following a 10-week training programme in my final A-Level year. The decision to reduce the number of sessions to four for the second mesocycle was sensible and still achieved performance gains. I made an increase of 15,3kg in my squat 1RM, whereas in my power clean tests I improved by 10kg. Interestingly, the increases made between pre-mid and mid- post were almost identical highlighting an even progression curve. In regards to the assisted

exercises, the sled pulls increased from 5kg to 12kg over 50m over the duration of the programme. This is a significant increase and should have caused a dramatic increase in the ability to recruit more muscle fibres and at a faster rate. Moreover, this probably contributed to increases in straight line speed. I tried to apply the “2 for 2” rule<sup>8</sup> as much as possible as recommended by a number of practitioners, such as Geiger (2017). However, I have been cautious with the increases and thus tried to listen to my body!

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Although, I stopped ½ squats after week 5, I included proprioceptive exercises, such as 1 legged squats on the BOSU with resistance. Therefore, this would account for continued increases in 1RM scores. I felt the inclusion of the proprioceptive sessions were positive, the BOSU 1-legged squat increased from 3 sets of 6 reps (body weight) to 3 sets of 6 reps with a 4kg medicine ball. 66

There has been a positive success in my 30m sprint tests- reducing the time from 5.2 - 4.8 seconds. However, I am still some distance from reaching my PB of 4.51 before the injury. The 30m hurdle sprint test improved by 0.4 seconds (6.4 - 6.0).. 50

The LSI scores of 0.925% (triple) and 0.900% (single) in the hop tests show that they fall within the acceptable boundaries recommended by Braegelmann et al. (2011). Therefore, the LSI scores along with the positive scores achieved in the 1RM tests show that I should be ready to return to competitive sport. Although, I am not as fast as I was before the injury, I believe that I am suffering as much from a psychological block as a physical deficiency. 78

In summary, I feel that the rehabilitation programme has been a success. It has been difficult to include so many different methods: interval, plyometric, assisted training and many more. However, I have achieved my goals in terms of developing strength and speed over the course of the Development Plan but not returning to competitive hurdling has been disappointing. 58

### **Future planning**

Reinold (2014) believes that the mental component involving fear of movement or reinjury, is often the last to come back to an athlete. During training, especially when hurdling, I experience fear of re-injury. Therefore, the next steps forward must be a form of psychological training. In Reese et al. (2012)'s study they found that out of many psychological strategies available guided imagery and relaxation correlated strongly with increased psychological coping and reduced re-injury anxiety. Therefore, this seems a good starting point that will hopefully increase my confidence and thus a return to competitive hurdling. My coach agrees that I need to incorporate psychological re-training along with competing in straight sprint races to build my self-confidence (appendix 3) 110

*Total word count - Performance Analysis 1723 + Development Plan 1744 = 3488*  
(excluding references, tables of data, charts, headings, footnotes & bibliography)

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<sup>8</sup> when 2 or more reps are achieved above the initial target number the weight can be increased

## Appendices

### Appendix 1 - 2 mesocycles that made up the Development Plan

*First mesocycle - 5 weeks*

monday	tuesday	wednesday	thursday	friday	saturday	sunday
.20' jog .Dynamic stretches .Running tech (skiping, high knees, side-steps) 25m reps (jog recovery REPEAT EACH EXERCISE  .Weight circuit 10kg + abs/lower back . 3 min slow, 2 min fast, 1 min top speed. .Repeat circuit and fartlek x2. .10x100m (grass) . Jogg	.20' jog .running tech. 25m . squat + power clean test .12x80 jogging back . jogg	20' jog (10' with hurdles at 100m intervals) .6 hurdles close together: mobility tech. . running tech. 25m .Horizontal jumps landing on the sand pitch . 10x100 at 90% back jogging . jog + stretch	. pectoral test .dynamic stretches with hurdles .hurdle velocity: 5x3 hurdles .velocity: 2x20+2x30+2x40 (3min recovery) .fartlek 25 min .100m speed+100m jogg+150(S)+100(J)+200(S)+100(J)+250(S)+100(J)+300(S)+100 (J) (repeat but going down, starting with 300m speed)	.30 min fartlek (3 min fast + 3 min low) .Gym: 2x10; ½ squat hamstrings power clean gastrocnemius .10x60m progressive running jogging back .jogg+stretch	rest day	rest day

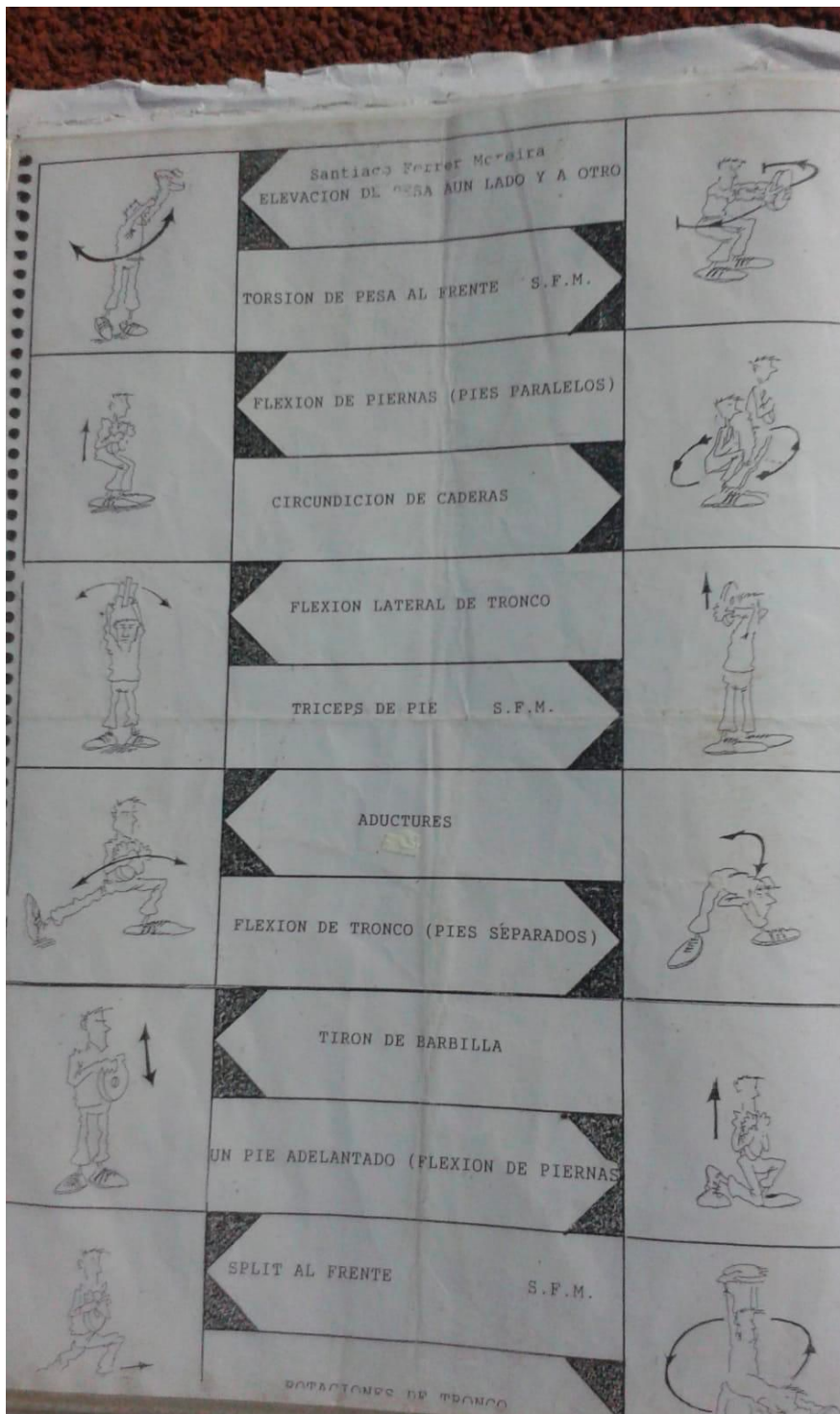
*Second mesocycle - 5 weeks*

monday	tuesday	wednesday	thursday	friday	saturday	sunday
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.15 min jogg .proprioception .Acceleration technique .5x20 recovery:1'30 min / pause 6 min .2(5x20m) recovery 20 sec +400m pause 6 min	Rest day	.Gym (upper body) .Rhythmic model over hurdles + 5x(40 max. speed + 40 submax) recover 3mins  .Max= amplitude running .submax=frequ ency running	15'min jogg .proprioceptive training .multi horizontal and vertical jumps .using sleds 7'5kg, acceleration technique over 50m  2x(3x200+500) 1min recovery in between 200 and 500, and 4mins pause in between blocks.	.Gym .5x(40 submax+40 max) .5x50 triple jumps .2x(5x20) recover :1min pause: 6 min .10'min jogg	rest day	rest day
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## Appendix 2

Pictures of exercises used in the weight training circuit



### Appendix 3

My coach's statement following the completion of my Development Plan:

Lucía ha completado su 'Development Plan' y he podido ver que ha mejorado su velocidad y sobre todo su fuerza positivamente, pero aun asi sigue teniendo dudas hacia las vallas y partes del entrenamiento que requieren movimientos rápidos y explosivos. Le recomiendo que siga un 'Psychological Development Plan' para que su confianza incremente y que antes de empezar con las vallas se dé la oportunidad de hacer 100m y 200m bajo condiciones de competición para que coja confianza.



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