

A Basic Meso-cycle to Improve Health-Related Fitness Components of A 100m Sprinter

V. Jasminan¹, A. W. S. Chandana¹

¹(Department of Sports Sciences and Physical Education, Sabaragamuwa University of Sri Lanka, Sri Lanka)

Abstract:

Background: The 100m sprint is one of the predominant events in the athletics discipline. Most athletes focus on skill-related fitness rather than health-related fitness. Health-related fitness components seem to be focused during their early preparation period to practice the skill-related components later. The study aimed to improve the health-related component of the athlete. This article expresses the way that training load is calculated and implemented to the athlete.

Materials and Methods An athlete who withdrew his sporting activity was selected and tested his initial performance of health-related fitness components. Using initial data annual plan was prepared and training load was estimated systematically. The first meso-cycle was applied to the athlete for eight weeks. After the eight-week training program again the same test was conducted to evaluate his current performance and it was compared with initial performance.

Results: As one subject participated in this study, the performance of pre-test and post-test was compared. Through this training program, the cardiovascular endurance (6%), strength endurance (16-21%), speed (4.1%), and flexibility (31.3%) of the athlete were improved.

Conclusion: From the findings, it's recommended to use the method introduced to calculate training load and can use this meso-cycle for the intermediate athlete during their early preparation period.

Key Word: 100m Sprint, Fitness components, Periodization, Training Load, Preparation

Date of Submission: 07-03-2022

Date of Acceptance: 23-03-2022

I. Introduction

The 100 meters or 100m dash is a sprinting event in track and field competition. It is the shortest popular competitive running distance and is recognized as one of the most prominent events in athletic competition. It is generally done on a typical running track known as "home straight". Nowadays, track and field participants are considered as important people in the competitive discipline.

A sprinter uses the skill-related components in different protocols to achieve maximum sprinting performance. The key components of the fitness with which each sprinter will achieve are reaction times, speed, and power. The immediate response to the gunfire of the race's start was regarded as more significant than the sprinters' actual pace¹. Many athletes will lose milliseconds because they have less time to respond than their opponents. More than 60m, athletes need to maintain their speed at maximum level, maintaining maximum speed leads to better performance. Power is a combination of speed and strength, it's very important to athletes to gain maximal acceleration.

However, athletes are needed to include health-related components in the preparation period in order to develop these skill-related components. The health-related components that need to develop are cardiovascular endurance, strength endurance, flexibility, and body composition^{2,4}. But they need to include these components in the early period of the training plan in order to avoid losing the specific skill-related components. Technical skills are also needed to improve in the early preparation period.

Therefore, the Annual training plan for an intermediate sprinter was designed to improve his sprinting performance. The first eight-week training program of the annual plan was introduced to the athlete. The first eight-week training programs consist of one meso-cycle (basic meso-cycle); and eight micro-cycles which include starting, introduction, preparatory, and regeneration micro-cycles.

The purpose of this annual training plan was to train an intermediate 100m sprint athlete who withdrew from his sport. This report provides all the necessary details of the annual training plan, session plans, how training load was applied, how performance was analyzed, and how the evaluation was made.

II. Material And Methods

A student from the Sabaragamuwa University of Sri Lanka, who withdrew from his sporting activity for nearly one year, was selected to train and to improve his health-related fitness in the early preparation period of the annual plan. The pre-test was conducted to identify his performance level and to prepare the annual plan, and according to the pre-test result training load for the athlete was determined. The athlete was allowed to do the warm-up based on his preference. Beep test, 35m Sprint, Push-ups, standing board Jump, Sit and Reach, and One Repetition Maximum (1RM) tests were conducted before and after the eight (08) week training program.

The simplest form of training plan “Monocycle” was constructed for one year, for the sprint athlete based on the pre-test performance. The duration of this year plan was approximately fifty-two (52) weeks. The general theory of periodization was used to prepare the annual plan. The training year was divided into three periods (Preparation period, Competition period, and Transition period), then periods were divided into sub-phases. General preparation and specific preparation come under the preparation period, and Pre-competition and competition come under the competition period. The ratio of weeks allocated for periods in this training plan was 70:25:05 for preparation, competition, and transition respectively. Table 01 shows the preparatory model of the annual plan. Then preparation period and competition period were divided into 6:4 ratio of its’ allocated weeks.

Training Load

In this annual plan, training load was calculated separately for speed, strength, and endurance. To measure the training load for speed training, volume was measured as total distance covered during training session and intensity was measured as, how fast athlete reaches 100m, for strength training volume was calculated as the total amount of weight lifted during training session and intensity was calculated as a percentage of one-repetition maximum, and for endurance training volume was calculated as total distance covered during training and the intensity was measured based on heart rate. Meso-cycle volume was measured using the following equation (5).

$$MC VL = \frac{Total VL}{SV\% of Each MC} \times Volume \% of MC$$

Where, MC, VL, and SV are Meso-Cycle, Volume Load, and Some of the Volume respectively. The total volume load for endurance training was set to 1,000km, for strength training was set to 1,250,000kg, and for speed training volume was set to 175,000m. Then they were divided into a reasonable percentage for each meso-cycles as shown in Table 02. The volume percentage shown in that table was estimated with the consideration of training theory and also the ability of the athlete. Then each meso-cycle volume was divided for its’ micro-cycles. Figure 01 shows volume load changes in eleven meso-cycles for endurance, strength, and speed.

Preparation Period

In the preparation period of this annual plan, thirty-six (36) weeks were allocated, then it was divided into two sub-phases (General Preparation – 22weeks and Specific Preparation – 14weeks) as shown in Table 01. The preparation period was constructed with seven (07) meso-cycles (Basic meso-cycle, Preparatory meso-cycle, Developmental meso-cycle, 2-Shock meso-cycles, and 2-Regeneration/recovery meso-cycles). Each of that meso-cycles consists of distinct objectives⁵.

The basic meso-cycle was constructed with eight (08) micro cycles. Relatively low training load was applied in this meso-cycle and training load increases only with volume instead of changing intensity and 3:1 step loading method was used to increase the load for this meso-cycle. The objectives have been set for this meso-cycle, mainly to increase the aerobic capacity, strength endurance, and work with technique and general speed. Table 03 shows the training load which was constructed for each micro-cycles for endurance, strength, and speed. To increase the training load in this meso-cycle, flat loading methods were used for endurance and speed. The step loading method (3:1) was used for the strength component⁵.

Micro-cycle and Session Plan

Eight (08) micro-cycles were included in the first meso-cycle of the annual plan. Each micro-cycles consist of the same training methods with different training load (load changes with volume and intensity). Each micro-cycles consist of five training sessions. The micro-cycle was designed with two high loadings, two low loading, one medium loading, and two rest days. Athlete’s training session was constructed in the usual way of including various units of activities such as endurance training, strength training, power training, skill lesson, and technical sessions between warm-up and cool-down sessions. For each session, goals were set to achieve and to evaluate the training effects.

The total volume load for endurance training in this meso-cycle was 100km (Table 02). The constructed volume for continuous running and fartlek training was 50:50 of its' micro-cycle training load. Table 04 shows the training volume and intensity of each session in all eight micro-cycles to enhance cardiovascular endurance. The training was performed on a 400m track. To maintain the phase of the training, the lap time was calculated and the athlete was requested to maintain the phase. As the fourth and eighth micro-cycles were regeneration micro-cycle, intensity and volume were reduced. Throughout the meso-cycle, the training load was changed by altering volume instead of altering intensity.

Table No 1: Preparatory Model of the Annual Plan

Factors	Units	Percentage
Periodization		
Annual plan (weeks)	52	100%
Preparation period	36	70%
Competition period	13	25%
Transition period (T)	3	5%
Sub Phases		% to its' period
General preparation (GP)	22	60%
Specific preparation (SP)	14	40%
Pre-competition (PC)	8	60%
Competition (c)	5	40%
Number of Meso-cycles		
Total	11	-
GP	4	-
SP	3	-
PC	2	-
C	1	-
T	1	-
Number of Micro-cycles		
Total	50	-
GP	22	-
SP	14	-
PC	8	-
C	5	-
T	1	-
No of Tests	7	
No of Competition	1	

Table No 2: Training Loads for Endurance, Strength, and Speed

Meso-cycles	Endurance		Strength		Speed	
	Volume %	Meso-cycle volume load (km)	Volume %	Meso-cycle Volume load (kg)	Volume %	Meso-cycle Volume load (m)
1	60	100	40	78,125.00	50	10,802.47
2	75	125	50	97,656.25	60	12,962.96
3	90	150	60	117,187.50	70	15,123.46
4	80	133.33	70	136,718.75	80	17,283.95
5	60	100	85	166,015.63	95	20,524.69
6	50	83.33	75	146,484.37	90	19,444.44

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7	45	75	65	126,953.12	85	18,364.20
8	40	66.67	60	117,187.50	80	17,283.95
9	35	58.33	55	107,421.87	75	16,203.70
10	35	58.33	50	97,656.25	75	16,203.70
11	30	50	30	58,593.75	50	10,802.47
Total	600	1,000km	640	1,250,000kg	810	175,000m

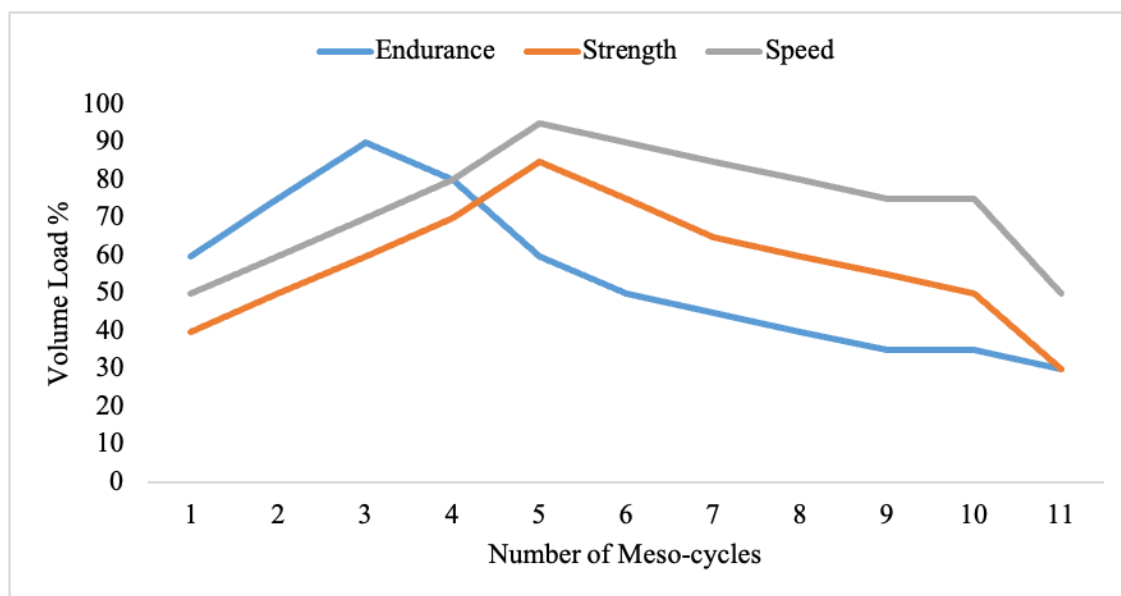


Figure 01: Volume Load changes throughout the Meso-cycle

Table No 3: Volume Load for First Eight Micro-cycles

Micro-cycles	Endurance		Strength		Speed	
	Volume %	Micro-cycle load (km)	Volume %	Micro-cycle load (kg)	Volume %	Micro-cycle load (m)
1	40	12.50	30	7,102.28	40	1,270.88
2	40	12.50	35	8,285.98	40	1,270.88
3	40	12.50	40	9,469.70	40	1,270.88
4	30	9.38	30	7,102.27	30	953.16
5	45	14.06	45	10,653.41	50	1,588.60
6	45	14.06	50	11,837.12	50	1,588.60
7	45	14.06	55	13,020.83	50	1,588.60
8	35	10.94	45	10,653.41	40	1,270.88

Table No 4: Endurance Training Load for Micro-cycles

Micro-cycle	Micro-cycle volume load (km)	Continuous run		Fartlek	
		Volume load (km)	Intensity (min/lap)	Volume load (km)	Intensity (%)
1	12.50	6.25	2	6.25	30, 35, and 40
2	12.50	6.25	2	6.25	30, 35, and 40

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3	12.50	6.25	2	6.25	30, 35, and 40
4	9.38	4.69	3	4.69	20, 30, and 35
5	14.06	7.03	2	7.03	30, 40, and 50
6	14.06	7.03	2	7.03	30, 40, and 50
7	14.06	7.03	2	7.03	30, 40, and 50
8	10.94	5.47	3	5.47	30, 40, and 50

Table No 5: Strength Training Load for Micro-cycles

Micro-cycle	Micro-cycle volume load (km)	Strength Endurance (1RM - 90kg)				
		Repetition	Sets	Exercises	Intensity (% of 1RM)	Volume load (kg) (approx.)
1	7,102.27	12	3	8	30	7,200
2	8,285.98	14	3	8	30	8,400
3	9,469.70	16	3	8	30	9,600
4	7,102.27	10	3	8	35	7,200
5	10,653.41	11	4	8	35	10,560
6	11,837.12	12	4	8	35	11,520
7	13,020.83	14	4	8	35	13,440
8	10,653.41	10	4	8	40	10,560

Table No 6: Speed Training Load for Micro-cycles

Micro-cycle	Micro-cycle volume load (km)	30m Acceleration			Wind sprint			Approx. total	
		Reps	Distance (m)	Volume load (m)	Reps	Sets	Distance (m)		Volume load (m)
1	1,270.88	20	30	600	5	2	60	600	1200
2	1,270.88	20	30	600	5	2	60	600	1200
3	1,270.88	20	30	600	5	2	60	600	1200
4	953.16	16	30	480	4	2	60	480	960
5	1,588.60	18	30	540	4	3	80	960	1500
6	1,588.60	18	30	540	4	3	80	960	1500
7	1,588.60	18	30	540	4	3	80	960	1500
8	1,270.88	16	30	480	4	2	80	640	1120

Table No 7: Intensity for Speed Training

Micro-cycle	Intensity	
	30m Acceleration (%)	Wind sprint (%)
1	50	50
2	50	50
3	50	50
4	50	50
5	60	60
6	60	60
7	60	60
8	60	60

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The volume load was calculated as a product of repetition, sets, number of exercises, and lifted weight for strength training. Table 05 shows the distributed repetitions, sets, intensity, and targeted or approximated volume load for each micro-cycles. One repetition maximum of athlete was 90kg which was taken from the pre-test result.

Table No 8: Monday Session Plan (From 25/11/2019 to 13/01/2020)

Date: 25/11/2019 to 13/01/2020
(All Mondays) **Time:** 4.30pm **Venue:** Outdoor track

Session Goal: 1) Complete estimated distance with phase
2) Core muscle strengthening

Personal coaching goal: Provide proper demonstration of exercises

Unit	Content	Coaching point
Warm up (20min)	1) Easy run (2-3laps) low intensity 2) Dynamic stretching 3) Running drills	1) Good Posture for exercise 2) Suggest other mobilization exercises
Main Part	1) Continuous running 25/11/2019 } 15-16laps & phase 2min/lap 02/12/2019 } 09/12/2019 } 16/12/2019 – 12laps & phase 3min/lap 23/12/2019 } 30/12/2019 } 17-18laps & phase 2min/lap 06/01/2020 } 13/01/2020 – 13-14laps & phase 3min/lap 2) Core muscle strengthening - abdominal crunch - sit ups - push-ups - plank - lateral crunch - side plank - bicycle crunch - mountain climb (10-16reps, 2-4 sets, 60-90sec rest between sets)	1) Good posture for running 2) Maintain rhythm 3) Cover a lap within 2min 4) Maintain good posture while doing exercise. 5) Stop if feel any pain 6) Demonstrate if needed
Cool Down	1) Two laps easy jogging 2) Static stretching 3) Massage	1) Hold stretching for 6-10sec 2) Questioning about session 3) Ask about any injuries 4) Advice to eat healthy food & sleep well

The basic meso-cycle consists of sixteen training sessions for general speed development, two sessions per a micro-cycle. Table 06 shows the repetitions, sets, volume load, and Approximated volume load for the basic meso-cycle for speed development. Table 07 shows the intensity of each session for speed development. The

first session was 30m acceleration from the block and the technical session was combined with it to introduce block start. One to three minutes (1-3min) rest interval was given between repetitions.

The session plan and training protocol for each day are displayed in Table 08 to Table 12. The training method for the same day will be the same, but the training load was changed, as volume and intensity were altered throughout the basic meso-cycle. Therefore, training volume & intensity were indicated in one session plan for a particular day. For example; session plan for Monday means, that the session plan covers all other Monday's session plan, as in the main part training volume and intensity was displayed with the dates of the training session.

Table No 9: Tuesday Session Plan (From 26/11/2019 to 14/01/2020)

Date: 26/11/2019 to 14/01/2020
(All Tuesdays) **Time:** 4.30pm **Venue:** Outdoor track

Session Goal: 1) Acceleration development
 2) Introducing block start

Personal coaching goal: Clear demonstration of block starting technique

Unit	Content	Coaching point
Warm up (20min)	1) Easy run (2-3laps) low intensity 2) Dynamic stretching 3) Running drills	1) Good Posture for exercise 2) Suggest other mobilization exercises
Main Part	1) Block start - On your mark - Set - Go 2) 30m acceleration from crouch start 26/11/2019 } 03/12/2019 } 20 reps & 50% intensity 10/12/2019 } 17/12/2019 – 16reps & 50% intensity 24/12/2019 } 31/12/2019 } 18reps & 60% intensity 07/01/2020 } 14/01/2020 – 16reps & 60% intensity 1-3min rest interval between repetition 100% Intensity = 13.76sec (100m)	1) Demonstrate crouch start technique 2) Look for body positioning 3) Check reaction to signal 4) Drive off front foot 5) Maintain same intensity 6) Suggest different start
Cool Down	1) Two laps easy jogging 2) Static stretching 3) Massage	1) Hold stretching for 6-10sec 2) Questioning about session 3) Ask about any injuries 4) Advice to eat healthy food & sleep well

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Table No 10: Wednesday Session Plan (From 27/11/2019 to 15/01/2020)

Date: 27/11/2019 to 15/01/2020 (All Wednesdays) **Time:** 4.30pm **Venue:** Gymnasium

Session Goal: 1) Strength endurance development
 2) Target lower body muscles more

Personal coaching goal: Technique correction and injury prevention

Unit	Content	Coaching point
Warm up (20min)	1) Easy run (2-3laps) low intensity 2) Dynamic stretching 3) Running drills	1) Good Posture for exercise 2) Suggest other mobilization exercises
Main Part	1) workout at gymnasium <ul style="list-style-type: none"> • Back squat • Leg press • Leg extension • Calves raise • Dead lift • Bench press • Shoulder press • Reverse lunges 27/11/2019 – 12reps, 3sets, & 30% intensity. 04/12/2019 – 14reps, 3 sets, & 30% intensity. 11/12/2019 – 16reps, 3sets, & 30% intensity. 18/12/2019 – 10reps, 3sets, & 35% intensity. 25/12/2019 – 11reps, 4sets, & 35% intensity. 01/01/2020 – 12reps, 4sets, & 35% intensity. 08/01/2020 – 14reps, 4sets, & 35% intensity. 15/01/2020 – 10reps, 4sets, & 40% intensity <ul style="list-style-type: none"> • (1-3min sets interval & 2-3min interval between exercises) • 30% intensity of 1RM (25kg approx.) 1RM – 90kg 	1) Good posture while doing exercise 2) Maintain rhythm of repetitions 3) Rhythm of exercise is slow 4) Stop if feel any pain 5) Demonstrate if needed
Cool Down	1) Two laps easy jogging 2) Static stretching 3) Massage	1) Hold stretching for 6-10sec 2) Questioning about session 3) Ask about any injuries 4) Advice to eat healthy food & sleep well

Table No 11: Thursday Session Plan (From 28/11/2019 to 16/01/2020)

Date: 28/11/2019 to 16/01/2020
(All Thursdays) **Time:** 4.30pm **Venue:** Outdoor track

Session Goal: 1) Complete estimated distance with phase.
 2) Core muscle strengthening

Personal coaching goal: Provide proper demonstration of exercises & indicate time of changing phase.

Unit	Content	Coaching point
Warm up (20min)	1) Easy run (2-3laps) low intensity 2) Dynamic stretching 3) Running drills	1) Good Posture for exercise 2) Suggest other mobilization exercises
Main Part	1) Fartlek training 28/11/2019 } 05/12/2019 } 15-16laps (30, 40, & 50 %) 12/12/2019 } 19/12/2019 – 12laps (20, 30, & 40 %) 26/12/2019 } 02/01/2020 } 17-18laps (30, 40, & 50 %) 09/01/2020 } 16/01/2020 – 13-14laps (30, 40, & 50 %)	1) Good posture for running 2) Maintain rhythm 3) Cover the total distance 4) Stop if feel any pain
Cool Down	1) Two laps easy jogging 2) Static stretching 3) Massage	1) Hold stretching for 6-10sec 2) Questioning about session 3) Ask about any injuries 4) Advice to eat healthy food & sleep well

Table No 12: Friday Session Plan (From 29/11/2019 to 17/01/2020)

Date: 29/11/2019 to 17/01/2020
(All Fridays) **Time:** 4.30pm **Venue:** Outdoor track

Session Goal: 1) General speed development
 2) Running technique development

Personal coaching goal: Demonstrate running action clearly

Unit	Content	Coaching point
Warm up (20min)	1) Easy run (2-3laps) low intensity 2) Dynamic stretching 3) Running drills	1) Good Posture for exercise 2) Suggest other mobilization exercises
Main Part	1) Wind sprint from standing start 28/11/2019 } 05/12/2019 } 5reps × 2set × 60m (I – 50%) 12/12/2019 } 19/12/2019 – 4reps × 2set × 60m (I – 50%) 26/12/2019 } 02/01/2020 } 4reps × 3set × 80m (I – 60%) 09/01/2020 } 16/01/2020 - 4reps × 2set × 80m (I – 60%) 1-2min rest between reps. 3-5min rest between sets.	1) Good posture for running 2) Maintain rhythm 3) Cover the total distance 4) Drive off foot 5) Good arm swing 6) High knee running.
Cool Down	1) Two laps easy jogging 2) Static stretching 3) Massage	1) Hold stretching for 6-10sec 2) Questioning about session 3) Ask about any injuries 4) Advice to eat healthy food & sleep well

III. Results & Discussion

The following Table 13 shows the pre-test, post-test results, and percentage of performance change in the selected health-related component of the athlete. Figure 02 shows, 35m acceleration performance was increased by 4.1% than initial performance. It ensures that the athlete's acceleration ability was increased through the eight-week training program. Normative data also ensure the performance was enhanced from good to very good (6).

Table No 13: Performance comparison before and after intervention

Test	Pre-test	Post-test	Δ%
35m Acceleration	4.83sec	4.63sec	4.1
Sit and Reach	16cm	21cm	31.3

Standing Long jump	2.72m	2.75m	8.2
Push-ups	38	46	21.1
Sit-ups (1min)	36	42	16.7
Beep test (VO ₂ max)	40.5ml/kg/min	42.9ml/kg/min	6
1RM test (squat)	90kg	90kg	0
1RM (bench press)	60kg	70kg	16.7
100m sprint	13.76sec	13.61sec	1.1

Figure 03 shows, that sit and reach performance was increased by 31.3% than initial performance. It ensures that the flexibility of the athlete was enhanced through this eight-week training program. Normative data of sit and reach also confirm the flexibility enhancement as it raised to excellent from good (6). Push-ups and sit-ups tests were conducted to evaluate the strength endurance of the athlete. As results show (Figure 04), it's clear that the strength endurance of the athlete was increased significantly by 21.1% in push-ups and by 16.7% in sit-ups. And normative data of both tests also ensure that enhancement. One of the major objectives of this training plan was achieved. The training load was mostly concentrated on strength endurance.

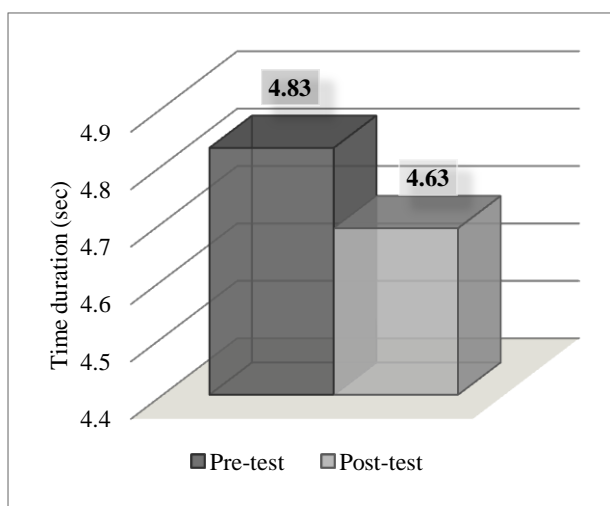


Figure 02: Comparison of 35m Acceleration Test

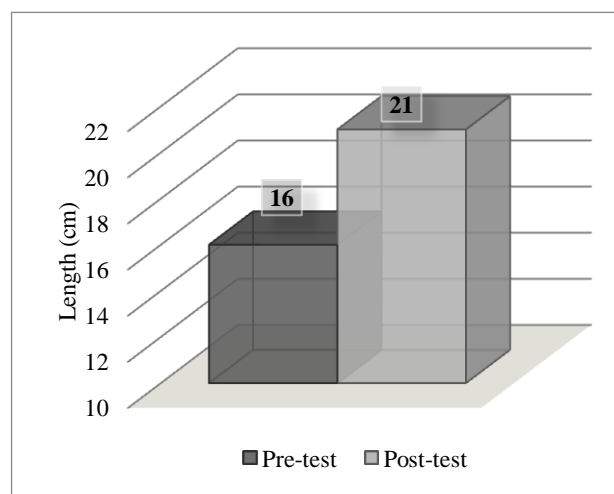


Figure 03: Comparison of Sit and Reach Test

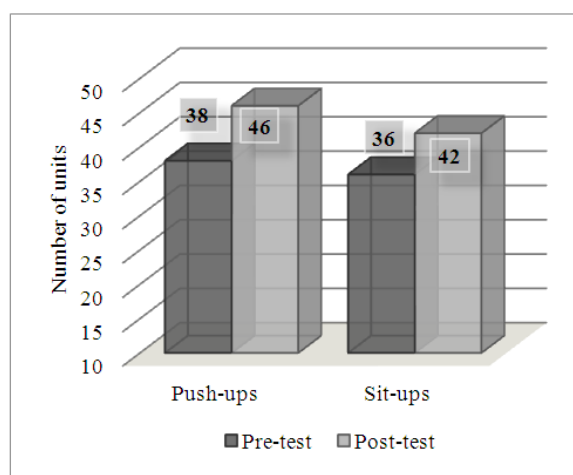


Figure 04: Comparison of Push-ups and Sit-ups Test

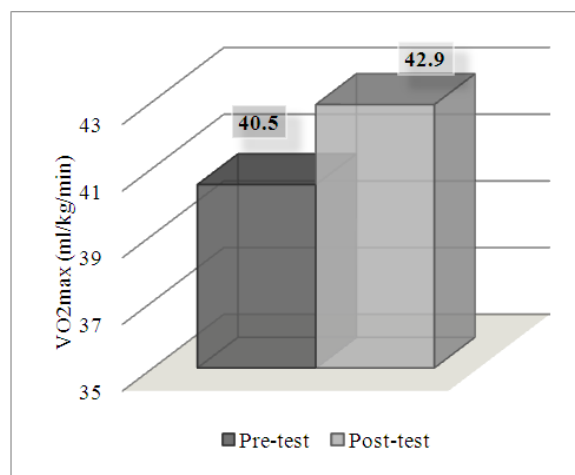


Figure 05: Comparison of Beep Test



Figure 06: Comparison of 1RM Test

The athlete has completed eight levels and one shuttle, therefore his VO₂max was 40.5ml/kg/min during the pre-test. During the post-test, the athlete has completed eight levels and nine shuttles, which means his VO₂max was 42.9ml/kg/min. This shows the performance increment of cardiovascular endurance. When comparing the test result of standing board jump, the distance jumped by an athlete in the post-test of standing board jump was slightly increased by 8.2% than pre-test. But the level of performance of athletes was excellent in both tests, as normative data indicate excellent (6). Even though the power ability was not increased compared to another fitness component. No changes were observed in the 1RM squat test. This means there is no maximum strength improvement through this eight-week training program. But in the bench press, the post-test result shows a significant improvement in one repetition maximum. However, in this first meso-cycle (basic meso-cycle) maximum strength wasn't targeted while aerobic endurance, strength endurance, general speed, and skill technique were mostly focused.

As this annual plan was designed for an athlete, it was implemented on an athlete. Therefore, it was unable to do statistical analysis and to find the treatment effects. Somehow, there is some evidence to encourage that the eight-week training program has enhanced cardiovascular endurance, strength endurance, flexibility, and general speed which are the basic training variables, that need to be trained in the preparation period. In the second meso-cycle, these variables are needed to be enhanced further.

IV. Conclusion

The annual plan was designed with the consideration of training principles and based on the pre-evaluation of selected fitness components of the athlete, and the first meso-cycle was trained to the athlete for eight (08) weeks. The main objective of the first meso-cycle was to improve aerobic endurance, strength endurance, general speed, and flexibility. From the pre-test and post-test comparison, there were performance improvements in fitness components and 100m sprint performance also slightly increased. But maximum

strength was not improved through this eight-week training program. The objectives of the study were achieved within the first meso-cycle through the periodization training plan for each component separately.

V. Recommendation

The effect of the training program was positive, therefore it's recommendable to use this training method in the early preparation period to enhance the health-related fitness components. Most of the training factors have been considered before preparing the annual plan. Therefore, it's suggestible to adopt this plan for the intermediate 100m sprint athletes. As one participant was trained, statistical analysis was not done, and unable to compare the training effect with other factors. In future, this method will be used to determine the effect of a training plan with a control group and with more samples.

In the future, the rest of the annual plan is going to be continued to prepare the athlete for the competition. Furthermore, the annual plan was constructed to avoid overtraining and it's recommendable to record the training load that has been done by the athlete for each session that will help to identify the effect and deficiencies of the training plan. If an athlete shows any overtraining syndromes, it's suggested to change the training load progressively and also by providing a regeneration program.

Declaration

The authors declare that this study does not contain any material previously published or written by another individual or myself except where the reference is cited in this report.

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V. Jasminan, et. al. "A Basic Meso-cycle to Improve Health-Related Fitness Components of A 100m Sprinter." *IOSR Journal of Sports and Physical Education (IOSR-JSPE)*, 9(02) (2022): 33-45.