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Sustainable Development of the Lavandula Dentate L. in Urban Parks in Southwestern Saudi Arabia

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Abstract:- Non-native plants can alter native plant populations in parks and may stimulate asymmetric spread and the emergence of invasive species. To manage invasive plants in urban gardens and to encourage sustainable growth, Lavandula dentata (LD) was used in the experiment. The experimental design was carried out in four urban parks using a randomized model, and the results were compared. 80 plant seedlings were used in an afforestation experiment in urban gardens with a 4 * 1 design, where 1 stand for the metric measurements of the plant (length), and Figure 4 shows the planting sites (P1, P2, P3, P4). The results show that the use of native plants in urban gardens (UP) has the potential to reduce the presence of invasive species and improve natural resource use efficiency and biodiversity. The plant used in the afforestation experiment had several visible effects, but an increase in germination rate and ability to flower after only 32 weeks of cultivation. Plant height increased due to morphological results. When the right environmental conditions are present, the plant can also grow and develop on its own after the seed lands on the ground. Finally, useful information about growth (LD) in urban gardens was revealed by the current study.

***Keywords*:-** *Sustainable Development, Parks, Non-Native Plants, Lavandula Dentata (LD).*

I. INTRODUCTION

Lavender (*Lavandula dentata*) is considered one of the ornamental plants used in gardens (Pérez-del Palacio, J. et al. 2020)

Because of its distinctive violet flowers and fragrant aroma, the plant is cultivated for its essential oil, which is used in aromatherapy, cosmetic compounds, and food processing. (Al Shaqhaa, 2013).

(LD) is aromatic plant that is characteristic of the southwestern regions of Saudi Arabia. Honeybees account for 97% of the insects attracted to flowers and produce the highest quality honey in the region. (Rocio Duarte, M. et al. 2014; Nuru, A. et al. 2015; Радев, 2020). An exotic plant is a plant that is introduced to a specific area where it was not present before, and then causes damage to the ecosystem in that area, in addition to the emergence of some economic and health damages (Al-Shahrani, 2012).

These invasive plants change the composition of the original plant community, thus affecting the diversity of plant species, threatening biodiversity, replacing local species, and affecting the process of economic and environmental balance (Pyšek et al., 2006).

Birds depend on the availability of native plants for their nutritional needs, hence the presence of native plants in urban parks helps to conserve nature and wildlife. Organisms are impacted by the invasion of non-native plants (Sabrina, I. et al. 2013).

It is advised that landscape architects employ local resources to improve the diversity of local grassland kinds like (LD) in parks and to exploit natural components to increase the stability of native species. (Chang Ch. et al 2021).

Visitors to the parks prefer the diversity of flower colors and the plant communities planted within them to achieve biological diversity (Tomitaka, M. et al. 2021).

So, the cultivation of (LD) may aid sustainable development in urban parks and enrich plant diversity.

II. MATERIALS AND METHODS

Work in the current research was designed to find out the possibility of developing strategies to appropriately direct the future development of the cultivation of native plants in the gardens and to benefit from the gardens ecologically and economically.

- *Sample Preparation*

Lavandula dentata samples prepared by the Institute of Beekeepers International Cooperative Association for Training in the Saudi Arabian city of Al-Baha were used in the current investigation.

- *Project Position and Plant Characterization*

The research was conducted in the Al-Mandaq territory, Al-Baha area, Kingdom of Saudi Arabia, At 20°09'45.8"N 41°17'04.9" E at 2243 meters over sea standard. The project zone was classified beneath the physiographic and climatic situation of the hill. Average wetness range (42.83). The average amount of precipitation is (11.5835) mm/year. The average minimum temperature is (17.65) and the maximum (30.05) degrees Celsius (Al-Baha Meteorological Station, 2021). The thoughtful Lavendula

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dentata fundamentally grows in thin to steep lands in surface and oolitic limestone-based earth types.

Lavendula dentata is a violently divaricate shrub species that reaches 75 cm in height. The leaves are aromatic, sessile, while longitudinal, over until 35 mm long, and 3 mm wide with robustly crooked edges. The inflorescences are intensive, for a terminal spike on to 7 cm tall. The plant is characterized by a remarkable adaptation to a long dry time by physiological inactivity. During the arid era, both leaves and spikes show fully dry, but, when there is due wetness, they fast continue their development and output many novel young shoots and bloom buds.

➢ *Afforestation in Gardens*

Seedlings were first prepared from the beekeepers' association and distributed to 4 parks of different locations and heights(Table 9). *Lavandula dentata* was planted by the municipality of Al-Mandaq Governorate, with a distance of half a meter between each seedling and seedling, according to the available spaces in each park, and followed up for a period of 32 weeks, as stated in previous studies.

- *Gardening experience*
- *Arborization protocol*

➢ *Experimental Design*

The experimental design was performed with a completely randomized design (CRD).80 seedlings of (LD) were planted in each site according to the areas available for cultivation in a completely random design, where each park differs from the other in space and height, The distance between each seedling was 50 CM randomly in the parks. I left the plant to reach the flowering stage, which extends to 90 days. (LD) was monitored environmentally for a period of 32 weeks. Each park includes a number of samples, between 10 and 30 samples of homogeneous age. Growth was observed and measured at planting and every 8 weeks until the end of the experiment, where the characteristics of the seedling formation such as stem lengths were measured. Measurements were collected and recorded at different temperatures, humidity, and winds according to climate data from the Ministry of Environment, Water, and Agriculture to analyze growth and development parameters in the samples.

- *The Protocol of the Experiment was*

✓ *P1; 30 Seedlings in the First Park*
✓ *P2; 10 Seedlings in the Second Park*
✓ *P3; 20 Seedlings in the Third Park*
✓ *P4; 20 Seedlings in the Fourth Park*

➢ *Plant Morphological Features Plant Height(Cm)*

A meter was used to measure the length when planting from the beginning of germination at the soil surface to the apex of the longest branch.

➢ *Germination Coefficients in Afforestation Experiment:*

Germination coefficients did by measuring the length of all transplanted seedlings every two months and at the end of the study. Calculate the plant growth rate by measuring the length Height is measured using a metric scale starting at the base of the plant at soil level to the highest point with a frequency of every 8 weeks.

➢ *Determine the Attributes and Characteristics of Parks:*

Determine the attributes and characteristics of parks at the level of the garden by determining the area of the garden, the age of the park, coordinates, height above sea level, direction of the mountainside, latitude, and longitude, distance from the main district, describing the internal component the presence of the lake and the remains of forests.

➢ *Non-Native Plants:*

Invasive plants change in the assembly of the original plant, a lowering in affluence and amplitude of local plants, swell potassium content in the earth and rise in herbivory on local plants. Where plant invasions impose higher herbivory on already declining local plants that way tired the sustenance of native plants. It can reason an after-time turn down of herbivores, who are serious nutrition exporter, for carnivores in these ecosystems (Rastogi, R. et al. 2023). Native plants have little resistance to invasive plants(Wang, Y. et al. 2022). The exotic Invasive species are usually hated due to their high pressure on indigenous societies (Kovács-Hostyánszki, A. et al. 2022).

➢ *Weather Data:*

Weather data were recorded in the increment into the points depicted above like heat, rainfall, prorated moisture, and wind for the region, at all times when sampling measurements were taken using data from the Ministry of Environment, Water and Agriculture.

➢ *Statistical Analyses:*

One-way ANOVA was performed on the obtained data and analyzed using the statistical package software (Microsoft Excel -version: 18.2210.1203.0). This helped compare the results of plant growth.

III. RESULTS

➢ *Seedling Establishment*

Seedling establishment standards were taken at planting and after every 8 weeks until we reached the flowering stage at 32 weeks.

➢ *Length*

Cultivation of the plant in the parks led to a development in plant height after following the plant for a period of 32 weeks. The average height of seedlings in (P1) at planting was (23.72 ± 6.798) to (39.07 ± 12.692) in week 32 (Table 1).In addition, the average length of seedlings in (P2) at planting was (22.95 ± 8.491) to (32.7 ± 9.19) in week 32 (Table 2). As it turned out, the average height of seedlings in (P3) at planting ranged from (23.78 ± 5.605) to (60.3 ± 11.499) in the 32 weeks (Table 3).The average height of seedlings in (P4) at planting shows (24.75 ± 5.149) to (70.45 ± 10.729) in week 32 (Table 4). The length was under the influence of many different climatic factors

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throughout the experiment period, such as temperature, humidity, wind, and the amount of rainfall. Hence, the amount of rainfall helped in better managing its height and flowering stage.

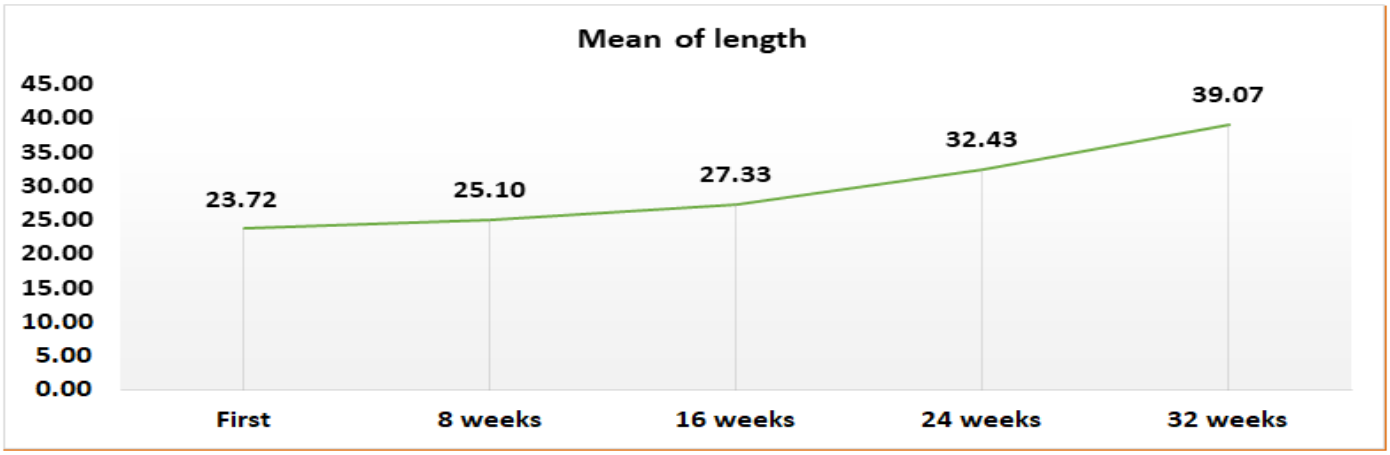

Fig 1 Average plant height (cm) for lavender (LD) used in afforestation in urban gardens. The graphic curve presents the continuous change of plant height during different weeks. The y-axis represents the height measurements (cm) and the x-axis the study period (in a week) for site P1.

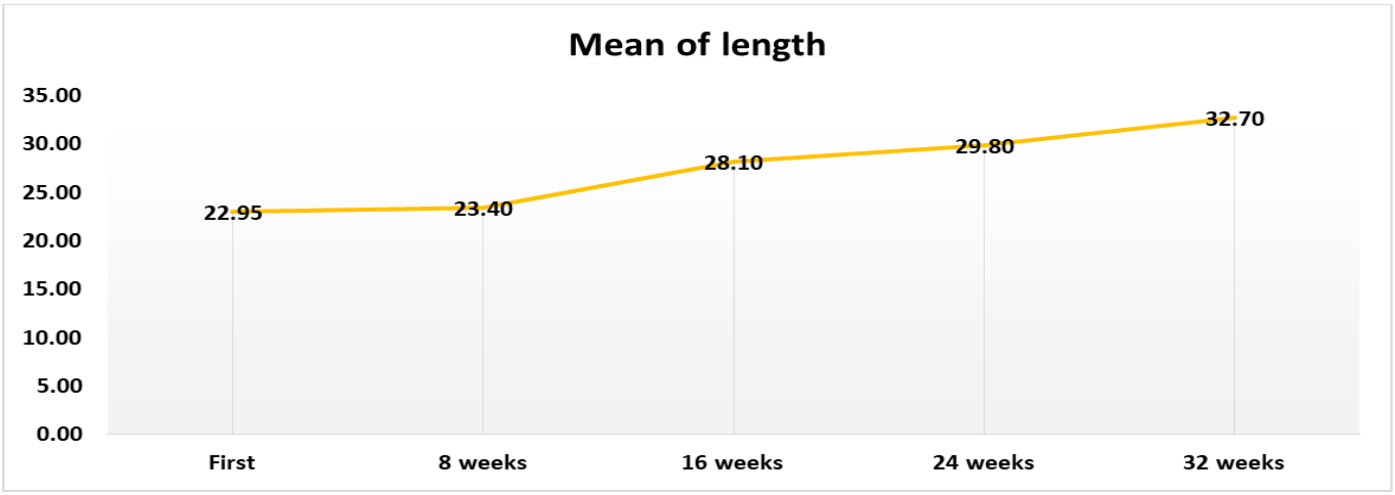

Fig 2 Average plant height (cm) for lavender (LD) used in afforestation in urban gardens. The graphic curve presents the continuous change of plant height during different weeks. The y-axis represents the height measurements (cm) and the x-axis the study period (in a week) for site P2.

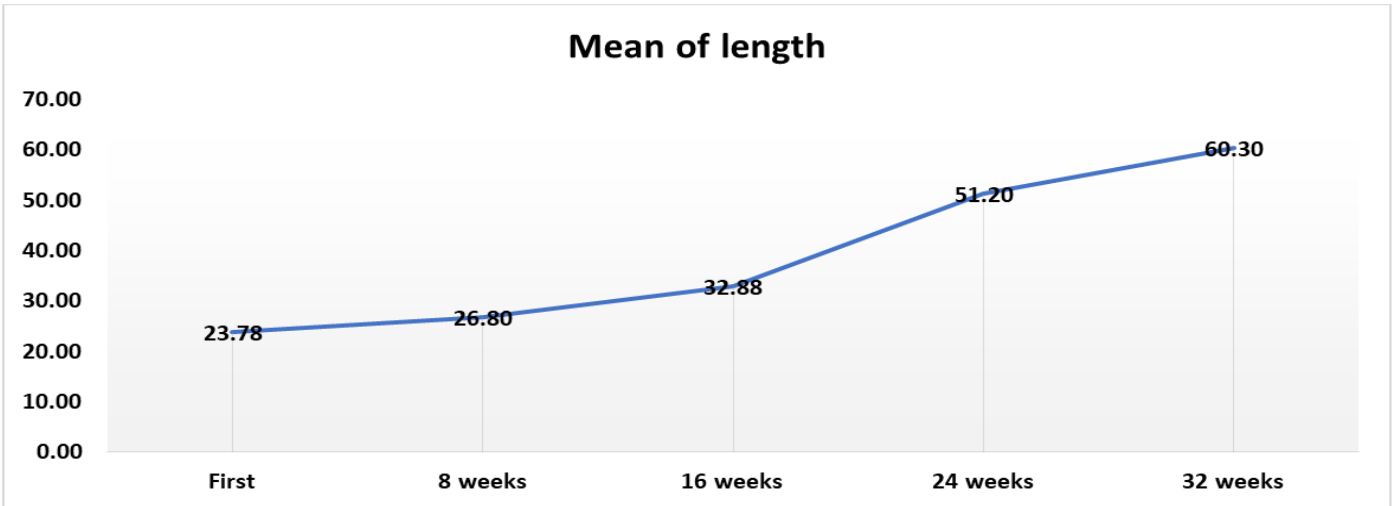

Fig 3 Average plant height (cm) for lavender (LD) used in afforestation in urban gardens. The graphic curve presents the continuous change of plant height during different weeks. The y-axis represents the height measurements (cm) and the x-axis the study period (in a week) for site P3.

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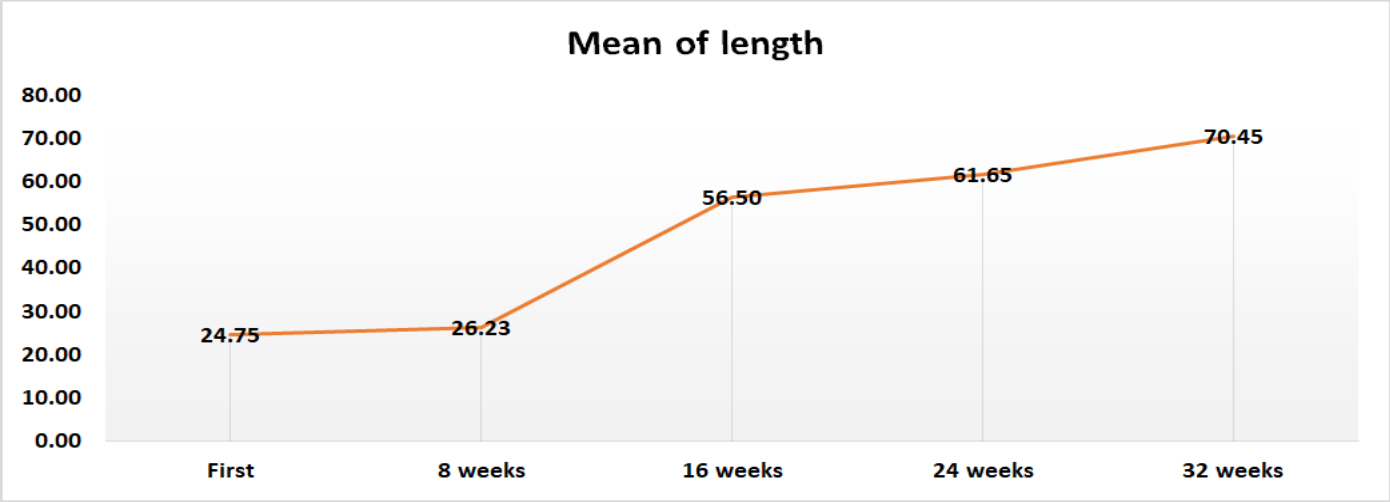

Fig 4 Average plant height (cm) for lavender (LD) used in afforestation in urban gardens. The graphic curve presents the continuous change of plant height during different weeks. The y-axis represents the height measurements (cm) and the x-axis the study period (in a week) for site P4.

➢ *Determine the Attributes and Characteristics of Parks:*

(Table 9) shows the most important features and characteristics of the (UP) used in the current study at the level of the park in general, by determining the area of the park, the age of the park, coordinates, height above sea level, direction of the mountainside, latitude, and longitude, distance from the main district As well as describing the internal component and the presence of the lake and the remains of forests.

Table 9 The Most Important Features and Characteristics of (Up) used in the Study at the Level of the Garden and the Indoor Component.

Parks	Space	Age of the garden	Location coordinates	Slope direction	Longitude and latitude	Height above sea level	Distance from the center of the province	Presence lake	Remnants forests
P1	4000m2	8years	20°14'11.1"N 41°13'01.5"E	western	Latitude 20.236378 Longitude 41.216606	2356.0 M	km 15 north	_	Yes
P2	1500m2	10years	20°12'52.0"N 41°13'33.7"E	between east and west	Latitude 20.214449 Longitude 41.226101	1983.0 M	km 11 northwest	-	-
P3	6800m2	4years	20°11'42.4"N 41°14'23.1"E	western	Latitude 20.195269 Longitude 41.239773	2132.0 M	km 7 northwest	-	-
P4	10,000m2	10years	20°04'38.4"N 41°19'27.9"E	east	Latitude 20.077959 Longitude 41.324043	2175.0 M	km 10 south	-	-

IV. DISCUSSION

The analysis of the score offered that yonder is a statistically worthy variance in the rise of the plants according to weeks, respectively, in urban parks. Tables 5 to 8 and figures 1 to 4 show the stages of increasing plant height over 32 weeks. Similar results are also documented in the work of (Nuru, A. et al.2015). Cultivation of (LD) in urban gardens led to the growth and development of the plant until it reached the flowering stage, and thus led to the stability of local species and the exploitation of natural resources in parks (Chang Ch. Et al 2021), where the plant responded and adapted in all the sites used for the study, which helps in sustainable development to the native plant (Echeverrigaray, S. et al. 2005)

In this study, plant seedlings showed an increase in growth rates, as climatic factors such as rainfall affect the increase in growth factors such as seedling length, width, and circumference.

(LD) is a garden-friendly plant because of the characteristics that distinguish it from other native plants (Giuliani, C. et al. 2020). Lavendula dentata is characterized by blue to violet flowers that add joy and beauty to the visitors of the parks, Park visitors prefer the variety of colors of flowers, and plant communities have grown within them to achieve biodiversity thus the results are consistent with the study Tomitaka, M. et al. 2021. In general, native plants can be used as valuable materials in urban park (UP)design to achieve sustainability and conservation of natural materials. The methodology of research supplies a framework for resolu-work about park landscape. It also makes it a facility for urban landscape managers and resolu-makers to understand the value of employing native plants and fecund plants in urban landscapes (Chang Ch. Et al 2021).

V. CONCLUSIONS

In the current study, the cultivation of (LD) in urban parks led to the keeping of normal resources while correlated with the stability of native type and conservation of environmental natural resources. The study also helped control non-native plants found in the parks and increase biodiversity. Thus, plant cultivation in urban parks helped address the negative impacts of alien plants by rehabilitating and cultivating sites infested with native species and achieving sustainable development. More studies are needed to support the current findings and provide more information on the use of native plants in parks.

RECOMMENDATIONS

The results of this study suggest a way to guide the management of urban parks that helps preserve local biodiversity, thus enhancing their ecological integrity. Searching for the most important plants within the environmental resources and exploiting them properly and taking care of them to achieve sustainable development. Reshaping and planting parks with environmental plants in order to benefit from local plants. Benefiting from the local plant to support the economy, as some species achieve high economic resources and are globally important. Taking into account soil maintenance and control methods, including fertilization, to maintain and enhance healthy soil that supports the healthy growth of plants. The region needs more developmental research. More studies to select the best native plant species for cultivation in urban parks (i.e. climate adaptation, diversity, more herbaceous perennials) Removing harmful vegetation to ensure the safety of visitors to urban parks.

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TABLES AND FIGURES

Table 1 Plant Height Measurements for (P1)

The Month	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower	Upper		
First	30	23.72	6.798	1.241	21.18	26.26	12	38
8 weeks	30	25.10	6.716	1.226	22.59	27.61	12	38
16 weeks	30	27.33	8.122	1.483	24.30	30.37	12	44
24 weeks	30	32.43	13.469	2.459	27.40	37.46	13	74
32 weeks	30	39.07	12.692	2.317	34.33	43.81	19	86
Total	150	29.53	11.359	.927	27.70	31.36	12	86

Table 2 Plant Height Measurements for (P2)

The Month	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower	Upper		
First	10	22.95	8.491	2.685	16.88	29.02	9	35
8 weeks	10	23.40	8.409	2.659	17.38	29.42	10	35
16 weeks	10	28.10	7.109	2.248	23.01	33.19	18	41
24 weeks	10	29.80	7.815	2.471	24.21	35.39	19	45
32 weeks	10	32.70	9.190	2.906	26.13	39.27	24	55
Total	50	27.39	8.750	1.237	24.90	29.88	9	55

Table 3 Plant Height Measurements for (P3)

The Month	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower	Upper		
First	20	23.78	5.605	1.253	21.16	26.40	14	33
8 weeks	20	26.80	4.789	1.071	24.56	29.04	17	34
16 weeks	20	32.88	6.274	1.403	29.94	35.81	20	45
24 weeks	20	51.20	9.197	2.057	46.90	55.50	34	69
32 weeks	20	60.30	11.499	2.571	54.92	65.68	43	90
Total	100	38.99	16.302	1.630	35.76	42.23	14	90

Table4 Plant Height Measurements for (P4)

The Month	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower	Upper		
First	20	24.75	5.149	1.151	22.34	27.16	15	34
8 weeks	20	26.23	6.902	1.543	22.99	29.46	17	41
16 weeks	20	56.50	12.068	2.698	50.85	62.15	43	84
24 weeks	20	61.65	8.254	1.846	57.79	65.51	49	77
32 weeks	20	70.45	10.729	2.399	65.43	75.47	52	89
Total	100	47.92	20.890	2.089	43.77	52.06	15	89

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Table 5 One-Way ANOVA Test (P1)

S.O.V	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4728.673	4	1182.168	11.826	.000
Within Groups	14494.822	145	99.964		
Total	19223.495	149			

Table 6 One-Way ANOVA Test (P2)

S.O.V	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	701.420	4	175.355	2.587	.049
Within Groups	3049.905	45	67.776		
Total	3751.325	49			

Table 7 One-Way ANOVA Test (P3)

S.O.V	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	20410.672	4	5102.668	82.162	.000
Within Groups	5899.950	95	62.105		
Total	26310.622	99			

Table 8 One-Way ANOVA Test (P4)

S.O.V	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	35545.040	4	8886.260	110.244	.000
Within Groups	7657.487	95	80.605		
Total	43202.528	99			