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Effect of Twelve Weeks of Physical Training on Sand Surface on Selected Physiological Variables

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Abstract:- Understanding the significance of physical training on sand surface and its potential benefits, the present study was conducted to investigate the effects of sand training on selected physiological variables. A total of 30 male college students of age ranging between 18-24 years were selected as subjects for the study which were equally randomized into two groups – Experimental Group and Control Group. The experimental group underwent the physical training regime on sand surface for a period of 12 weeks, while the control group was not involved in any type of training during that period. Subjects were assessed before the training (pre-test), during the training (mid-test), and after the training (post-test) for three physiological variables – fat percentage using skinfold calipers, aerobic power using 12-minutes Cooper's run/walk test, and anaerobic power using Running-based Anaerobic Sprint Test (RAST). One-way Repeated Measures ANOVA was used as the statistical technique to analyze the data by taking 0.05 as level of significance. The results showed that sand training significantly improves aerobic power and anaerobic power, while decreasing the fat percentage.

Keywords:- Sand surface, Fat percentage, Aerobic power, Anaerobic power

I INTRODUCTION

Sand training is a unique and effective method of physical conditioning that leverages the natural resistance and instability of sand surfaces to enhance athletic performance. Unlike traditional training surfaces like grass or synthetic turf, sand provides a higher energy cost and lower impact stimulus, making it an excellent choice for athletes looking to improve their endurance, strength, and overall fitness (Gaudino, Gaudino, Alberti, & Minetti, 2013; Impellizzeri et al., 2008; Lejeune, Willems, & Heglund, 1998; Pinnington & Dawson, 2001a, 2001b; Zamparo, Perini, Orizio, Sacher, & Ferretti, 1992).

Research has shown that sand training can lead to significant physiological and biomechanical adaptations. For instance, a study by Binnie et al. (2014) found that sand surfaces can reduce muscle damage and soreness compared to firmer surfaces, allowing athletes to train more intensely without compromising their performance (Impellizzeri et al., 2008; Miyama & Nosaka, 2004). Additionally, the lower impact forces experienced on sand can

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help in reducing the risk of injuries, making it a safer option for high-intensity training (Barrett, Neal & Roberts, 1998).

Another study by Binnie et al. (2013) highlighted the benefits of sand training for team sports. The study suggested that training on sand can positively influence firm-ground performance by enhancing muscle power and sprint speed. The unique characteristics of sand, such as its instability and resistance, require greater muscle activation and coordination, leading to improved neuromuscular control and functional strength.

Moreover, sand training is accessible and cost-effective, as it can be performed on natural beaches or artificial sand surfaces (Gaudino et al., 2013; Lejeune et al., 1998; Pinnington & Dawson, 2001a; Zamparo et al., 1992). This makes it a practical option for athletes and coaches looking to incorporate variety into their training programs. Nikolaidis et al. (2018) in the International Journal of Sports Physiology and Performance demonstrated that sand training improves neuromuscular control, reduces injury risk, and promotes more efficient movement patterns. These multifaceted benefits make sand training a comprehensive approach to physical fitness, targeting strength, endurance, coordination, and overall athletic performance across various fitness parameters.

Hence, sand training offers a range of benefits, including reduced injury risk, improved muscle strength and power, and enhanced athletic performance1. As research continues to explore its applications, sand training is likely to become an increasingly popular method for athlete preparation and conditioning. Although, the field of sand training has been well researched, but its impact on physiological variables is not studied in details. There is scarcity of literature on the influence of sand training on physiological variables. So, the researcher decided to fill this literature gap by investigating the effect of physical training on sand surface on selected physiological variables.

II METHODOLOGY

Selection of Subjects

For the purpose of the study, a total of 30 healthy male college students were selected as subjects whose age range between 18-24 years. All the selected subjects were randomized equally into Experimental Group and Control Group. Subjects were free from any sort of injury or musculo-skeletal disorders and were fit to undergo sand training and data collection procedure. All the subjects were explained the purpose of the study and consent forms were taken.

Training Program

The experimental group was given training for physical fitness on sand surface for 12-weeks while the control group was not involved in any sort of training during the intervention period. The sand training was given thrice a week on alternate days i.e. Monday, Wednesday, and Friday. The detailed training program is mentioned in the table below.

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Table 1: Training Program for 12 weeks for experimental group

Drills	1st & 2nd	3rd & 4th	5th & 6th
30-m Sprints	2 x 30-m	3 x 30-m	4 x 30-m
Hurdle Hops	2 x 10	3 x 10	4 x 10
Shuttle Runs	2 x 10-m	3 x 10-m	4 x 10-m
Burpees	2 x 10	3 x 10	4 x 10
Lateral Shuffles	2 x 20-m	3 x 20-m	4 x 20-m
Zig-Zag Runs	2 x 20-m	3 x 20-m	4 x 20-m

Drills	7th & 8th	9th and 10th	11th & 12th
30-m Sprints	4 x 30-m	5 x 30-m	6 x 30-m
Hurdle Hops	4 x 12	5 x 12	5 x 15
Shuttle Runs	4 x 15-m	5 x 15-m	6 x 10-m
Burpees	4 x 12	4 x 15	5 x 15
Lateral Shuffles	4 x 20-m	5 x 20-m	6 x 20-m
Zig-Zag Runs	4 x 20-m	5 x 20-m	6 x 20-m

Data Collection

The data was collected before the start of training i.e. pre-test, during the training at the end of 6th week i.e. mid-test and after the completion of training i.e. post-test.

The data was collected on the following selected physiological variables – fat percentage, aerobic power, and anaerobic power. Fat percentage was assessed with skinfold calipers. Aerobic power was measured using Cooper's 12-minute run/walk test, and anaerobic power was measured using Running-based Anaerobic Sprint Test (RAST).

Statistical Analysis

Descriptive statistics is presented below to understand the nature of data. To analyze the data, One-way Repeated Measures Analysis of Variance (ANOVA) was used to compare the performance at different time points after satisfying the assumption of normality of data using Shapiro-Wilk test. The level of significance was set at 0.05.

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Results

Table 2: Descriptive statistics (Mean ± Standard Deviation) of selected physiological variables at different time points

Variable	Group	Pre-test	Mid-test	Post-test
Fat Percentage	EG	11.705 ±1.63	11.274 ± 1.60	10.877 ± 1.56
	CG	11.880 ± 1.96	11.908 ± 1.95	11.926 ± 0.196
Aerobic Power	EG	43.311 ± 3.50	45.168 ± 3.28	48.064 ± 3.21
	CG	42.610 ± 2.99	41.897 ± 3.08	40.986 ± 2.97
Anaerobic Power	EG	443.224 ± 51.57	470.152 ± 41.67	496.56 ± 56.16
	CG	438.426 ± 68.89	428.750 ± 80.37	425.619 ± 79.79

Table 3: Result of One-way Repeated Measure ANOVA for Experimental Group

Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Fat Percentage	5.145	2	2.572	89.368	0.000
Aerobic Power	172.109	2	86.055	384.173	0.000
Anaerobic Power	21342.519	2	10671.260	194.642	0.000

The statistical output shown in the Table 3 represent that there is significant difference in the fat percentage, aerobic power, and anaerobic power at different time points as the p-value is less than 0.05. Since, the differences in the mean values at different time points is significant, pairwise comparison was performed by taking two time points at a time using Sidak post hoc test.

Table 4: Pairwise Comparison at different time points for Experimental Group

Variable	(I) time	(J) time	Mean Difference	Std. Error	Sig.
Fat Percentage	Pre	Mid	0.431	0.072	0.000
	Pre	Post	0.828	0.076	0.000
	Mid	Post	0.397	0.021	0.000
Aerobic Power	Pre	Mid	-1.857	0.127	0.000
	Pre	Post	-4.753	0.179	0.000
	Mid	Post	-2.896	0.203	0.000
Anaerobic Power	Pre	Mid	-26.927	2.556	0.000
	Pre	Post	-53.334	1.185	0.000
	Mid	Post	-26.417	3.741	0.000

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Table 4 showed the pairwise comparison of selected physiological variables at different time points.
There is significant difference in the mean values of pre-test and mid-test, pre-test and post-test, and mid-test and post-test, as the p-values for each of the comparison is less than 0.05.

Table 5: Result of One-way Repeated Measure ANOVA for Control Group

Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Fat Percentage	0.017	2	0.008	5.052	0.053
Aerobic Power	19.895	2	9.947	28.368	0.000
Anaerobic Power	1337.290	2	668.645	3.080	0.062

As per the results of table 5, there is significant difference in the aerobic power performance of subjects of control group at different time points, while there is no significant difference for fat percentage and anaerobic power. The post-hoc test will be applied for aerobic power only.

Table 6: Pairwise Comparison at different time points for Control Group

Variable	(I) time	(J) time	Mean Difference	Std. Error	Sig.
Aerobic Power	Pre	Mid	0.713	0.216	0.015
	Pre	Post	1.625	0.257	0.000
	Mid	Post	0.911	0.167	0.000

The pairwise comparison of aerobic power of control group revealed that there is significant difference in the pre-test and mid-test (p=0.015), pre-test and post-test (p=0.000), and mid-test and post-test (p=0.000).

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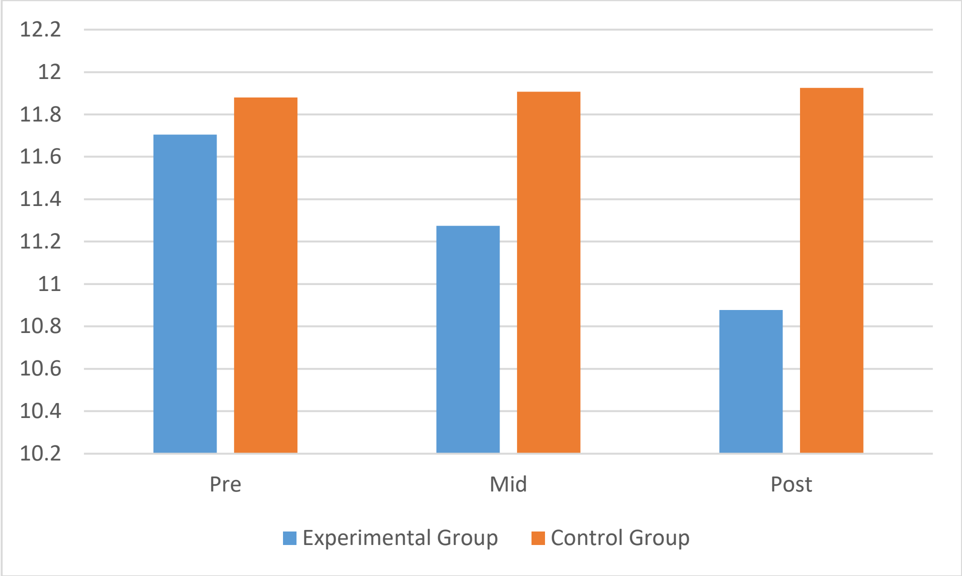

Figure 1: Graphical Representation of Fat percentage of experimental and control group at different time points

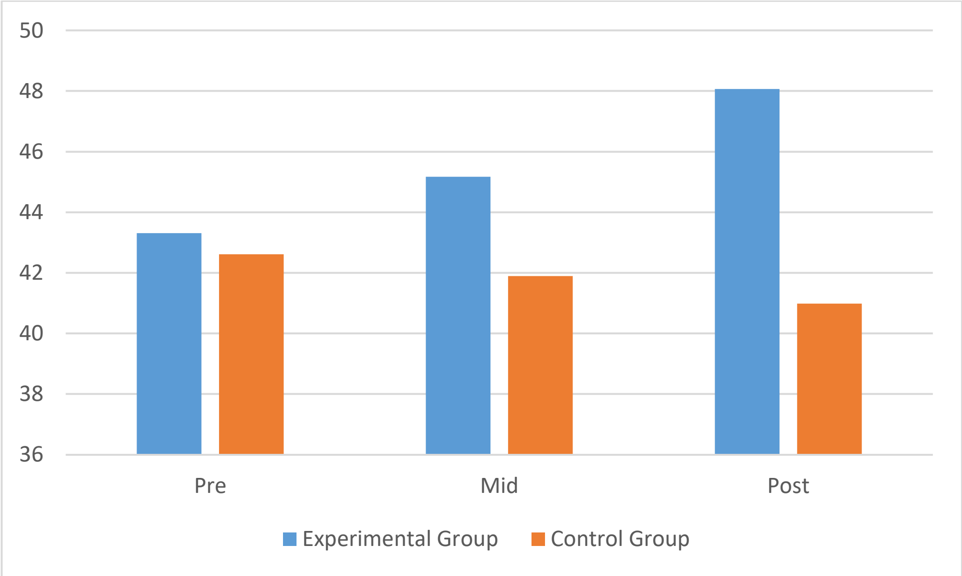

Figure 2: Graphical Representation of Aerobic power of experimental and control group at different time points

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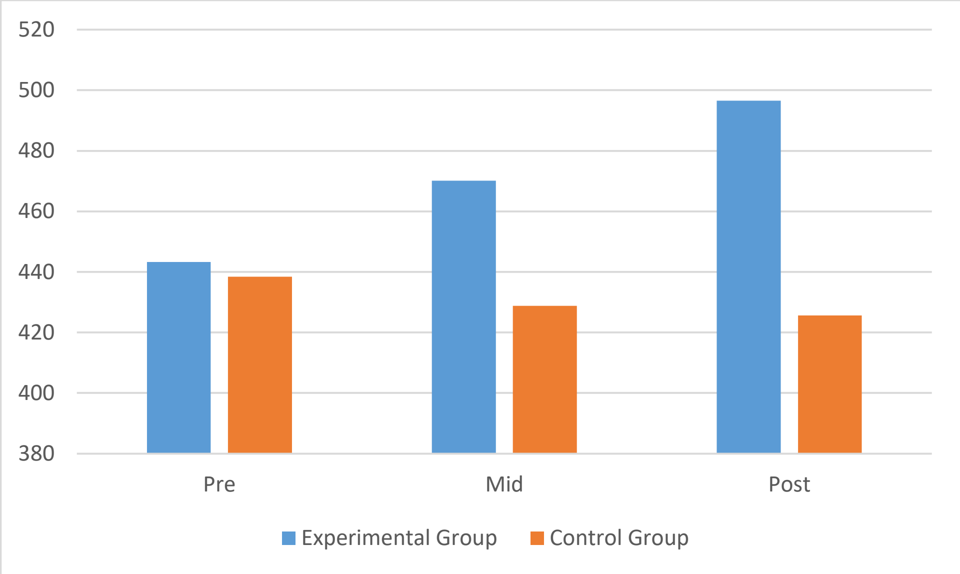

Figure 3: Graphical Representation of Anaerobic power of experimental and control group at different time points

III DISCUSSION

The present study was conducted with the purpose to investigate the effect of physical training on sand surface on the following physiological variables – fat percentage, aerobic power, and anaerobic power. The results of the study showed that the experimental group which was given twelve weeks of physical training on sand surface significantly improved displayed enhanced aerobic and anaerobic power, and while significant decrease in the fat percentage at mid-test and post-test. In case of control group, no significant differences were observed for changes in fat percentage and anaerobic power, while aerobic power significantly decreased at mid-test ad post-test.

For experimental group, fat percentage decreased from 11.705 to 11.274 at end the 6th week and 10.877 after twelve weeks of sand training. Similarly, aerobic power improved from 43.311 to 45.168 and 48.064 after 6th week and 12th week respectively. Anaerobic power also improved from 443.224 to 470.152 and 496.56 after 6th week and 12th week respectively. Control group's fat percentage slightly increased from 11.88 to 11.926 after 12 weeks. Anaerobic power decreased from 438.426 to 425.619 after 12 weeks. Aerobic power was significantly decreased from 42.61 to 41.897 and 40.986 after 6th week and 12th week respectively.

Sand training has been shown to effectively enhance aerobic capacity through unique physiological challenges. A study by Binnie et al. (2014) demonstrated that running on sand requires significantly more energy expenditure compared to firm ground, leading to improved aerobic performance. Specifically, the increased muscular demands and unstable surface create a higher metabolic cost, which stimulates cardiovascular adaptations.

Research by Leite et al. (2017) found that athletes engaging in sand-based training experienced a 12-15% increase in maximal

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oxygen uptake (VO2 max) compared to traditional ground training. This improvement is attributed to the additional muscular recruitment and resistance provided by the sand environment.

Sand training uniquely challenges anaerobic power through increased muscular resistance and neuromuscular activation. A study by Markovic et al. (2016) revealed that sand-based sprint and jump training significantly improved anaerobic power output by 8.3-11.6%. The unstable surface forces greater muscle activation and requires more explosive power generation.

Binnie et al. (2014) further noted that the increased mechanical work required during sand training leads to enhanced neuromuscular coordination and power production, particularly in lower body muscle groups.

The metabolic demands of sand training contribute substantially to body composition changes. Miyamoto et al. (2015) demonstrated that high-intensity interval training on sand resulted in a 3.5-4.2% reduction in body fat percentage over an 8-week training period. This reduction is primarily due to the elevated energy expenditure and increased metabolic stress associated with sand-based exercises.

A comparative study by Leite et al. (2017) showed that sand training participants experienced a more significant fat loss compared to traditional ground training, with approximately 2.8% greater fat mass reduction.

IV CONCLUSION

Sand training benefits are driven by several mechanisms. The unstable surface increases muscular activation, engaging stabilizing muscles like the core and lower body more effectively. It demands higher energy expenditure than firm ground, with up to 1.5 times more calories burned due to the energy absorbed with each step. Additionally, sand training enhances neuromuscular coordination by requiring continuous adjustments for balance and movement. The soft and yielding nature of sand amplifies mechanical work demands, as muscles must generate greater force to overcome resistance. This surface also minimizes joint impact, making it a low-risk option for high-intensity exercise or injury recovery

From a practical standpoint, sand training is an excellent tool for athletes and fitness enthusiasts. It improves both aerobic and anaerobic performance by challenging cardiovascular and muscular systems simultaneously. Its high-calorie burn and metabolic demands aid in reducing body fat percentage while fostering overall athletic conditioning. The reduced joint stress makes it a safer alternative for high-intensity workouts, supporting recovery and injury prevention. Incorporating sand training into fitness routines can help build strength, endurance, and coordination, making it a versatile addition for achieving diverse fitness.

References

1. Barrett, R. S., Neal, R. J., & Roberts, L. J. (1998). The dynamic loading response of surfaces encountered in beach running. Journal of Science and Medicine in Sport, 1(1), 1–11.
2. Binnie, M. J., Dawson, B., Pinnington, H., Landers, G., & Peeling, P. (2013a). Effect of training surface on acute physiological responses after interval training. Journal of Strength and Conditioning Research, 27(4), 1047–1056.
3. Binnie, M. J., Dawson, B., Pinnington, H., Landers, G., & Peeling, P. (2013b). Part 2: Effect of training surface on acute physiological responses after sport-specific training. Journal of Strength and Conditioning Research, 27(4), 1057–1066.

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SGVU International Journal of Convergence of Technology and Management
E-ISSN: 2455-7528
Vol.12 Issue 1 Page No 260-268

4. Binnie, M. J., Peeling, P., Pinnington, H., Landers, G., & Dawson, B. (2013c). Effect of surface-specific training on 20 m sprint performance on sand and grass surfaces. Journal of Strength and Conditioning Research, 27(12), 3515–3520.
5. Gaudino, P., Gaudino, C., Alberti, G., & Minetti, A. E. (2013). Biomechanics and predicted energetics of sprinting on sand: Hints for soccer training. Journal of Science and Medicine in Sport, 16, 271–275.
6. Impellizzeri, F. M., Rampinini, E., Castagna, C., Martino, F., Fiorini, S., & Wisloff, U. (2008). Effect of plyometric training on sand versus grass on muscle soreness and jumping and sprinting ability in soccer players. British Journal of Sports Medicine, 42, 42–46.
7. Lejeune, T. M., Willems, P. A., & Heglund, N. C. (1998). Mechanics and energetics of human locomotion on sand. Journal of Experimental Biology, 201, 2071–2080.
8. Pinnington, H. C., & Dawson, B. (2001a). The energy cost of running on grass compared to soft dry beach sand. Journal of Science and Medicine in Sport, 4(4), 416–430.
9. Pinnington, H. C., & Dawson, B. (2001b). Running economy of elite surf iron men and male runners, on soft dry beach sand and grass. European Journal of Applied Physiology, 86, 62–70.
10. Pinnington, H. C., Lloyd, D. G., Besier, T. F., & Dawson, B. (2005). Kinematic and electromyography analysis of submaximal differences running on a firm surface compared with soft, dry sand. European Journal of Applied Physiology, 94, 242–253.
11. Zamparo, P., Perini, R., Orizio, C., Sacher, M., & Ferretti, G. (1992). The energy cost of walking or running on sand. European Journal of Applied Physiology and Occupational Physiology, 65, 183–187.

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