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OPTIMIZING FOOTBALL TRAINING AT MULTAN SPORTS COMPLEX: INTEGRATING PORTABLE FORCE PLATES FOR ADVANCED PERFORMANCE ANALYSIS

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ABSTRACT

Introduction

This research aimed to apply portable force plates to enhance football training at Multan Sports Complex.

Method

Thirty male football players, between the age of 18 and 35 years, were selected and randomly placed in the portable force plate group or a conventional training group. The participants in this study were subjects of the intervention group who received a 12-week force plate training program consisting of training sessions 3-4 times a week to enhance specific movement characteristics.

Result

Statistical analysis revealed differences in the VHJT and FMS scores between the two groups In addition, ACSI scores for the intervention group were also higher than that of the control group. The explosive power, neuromuscular coordination, and movement efficiency were higher in the intervention group than in the control group.

Conclusion

In light of the outcome of the study, it was clear to suggest that the inclusion of force plates particularly portable ones into football training can indeed help in the improvement of athletic performance and reduction of risks commonly incurred during training and eventually games hence, supporting football training and hence individualized coaching with scientific evidence.

Key Words: Athletic performance, Biomechanical analysis, Football training, Functional movement screening, Injury prevention, Portable force plates

INTRODUCTION

Football games are the most significant secondary events in the globe because they draw large crowds to stadiums and television screens. This fast-paced, extremely dynamic team game fits within the poly-structural sports game genre because of its abundant mobility. Football is a sport that involves a wide range of complex, dynamic kinesiological activities that may be classified as either cyclical or acyclical. (Gardasevic & Bjelica, 2020) The quest for novel approaches to improve player performance while reducing injury risks is what keeps football training a dynamic and ever-changing field. Athletes and coaches committed to honing training methodologies find a central hub at the Multan Sports Complex within this context. (Badby et al., 2023; Błaszczyk & posture, 2016)

Playing at one's peak in football—a sport adored worldwide—requires not only physical strength and agility but also technical proficiency, tactical awareness, and mental toughness.(Smith & Ditroilo, 2023; Strotmeyer et al., 2018). This means that football training is more than just getting in shape; it's also about improving one's skills, learning the game's strategies, and avoiding injuries.(Jogi et al., 2016) Conventional approaches may be imprecise when it comes to the intricacies of football training, especially when it comes to comprehending the biomechanics, force exertion, and movement patterns of players. The use of portable force plates addresses this issue by giving coaches precise, real-time data on ground reaction forces, allowing them to create individualized training programs for each player.(Karlsson & Frykberg, 2000; Lee & Sun, 2018)

Football coaches face the challenge of constantly monitoring and evaluating their players' physical performance and preparedness. Field tests and wearable devices are examples of traditional methods, but they have their limits due to equipment requirements and environmental factors(Lee & Sun, 2018). The importance of this study rests in the fact that it can completely change the way football training is done. By providing more detailed information about biomechanical aspects, it will be easier to implement specific interventions that improve performance, prevent injuries, and aid in rehabilitation(Loturco et al., 2018).

An athletic injury not only causes athletes to lose their ability to cope with the game, but it also costs money and takes time for them to go back to the gym. Analyzing the injury's etiology is the first step in preventing one of them. These variables are divided into internal and external risk

factors after the analysis (Yang et al., 2022). Athletes are susceptible to external influences like physical elements, whereas internal risk factors include the biological, psychological, and social traits of an individual that lead to an injury (Beck & Drysdale, 2021) Internal risk factors for acute injuries brought on by stress and overuse injuries include psychological issues.(Lockhart et al., 2022)

Keeping up with the latest technological developments is essential in the ever-changing world of competitive sports.(Smith et al., 2023; Smith & Ditroilo, 2023). The use of portable force plates at the Multan Sports Complex could put it at the forefront of innovative training methods, which is in line with the worldwide trend toward data-driven approaches in sports science.(Mansfield et al., 2015; Merrigan et al., 2021b). Portable force plates have many uses in football, from youth development to elite competition, and not only in the professional league. This study's findings can be applied to various training environments, making it a useful resource for sports scientists, physiotherapists, and coaches who deal with athletes of all ages and abilities.(Miller et al., 2023; Parry et al., 2021).

This study aimed to show that portable force plates accurately assess performance when applied in a football training program at Multan Sports Complex, hence enhancing training features and reducing injuries. This technique offered feedback at an individual level, which enabled trainers to offer individualized training schedules. It also enabled data-driven coaching, which could benefit the complex by making it more competitive and making the training center well-known as the sporting hub.

METHODOLOGY

The IRB committee (FAHS/DPTRS/2/24/MS/RS-3377) authorized the study design, which was a randomized control experiment. The head of the sports committee selected football players from the Multan Sports Club in District Multan. Using a computer-generated randomization sequence, participants were randomized to either the intervention group (using portable force plates) or the control group (normal training without force plates). It was established that there were thirty players in the sample. G*Power was used to determine this sample size, with an effect size of 0.5, a power of 0.80, and a significance level (alpha) of 0.05. A paired t-test was

the statistical test used to determine sample size, taking into account the means of performance measures both before and after the integration of portable force plates. (Miller et al., 2023) A non-probability convenient sampling technique was applied in this investigation. Nine months after the summary was approved, the study was finished. The following requirements had to be met to be included: i) male football players between the ages of 18 and 35 who were registered players at the Multan Sports Complex; ii) ability to comprehend and adhere to course instructions; and iv) willingness to provide informed consent. those who, during the last six months, have employed force plate technology. Unstable medical conditions, players with ongoing injuries or illnesses that prevent them from participating fully, and players who were not registered with Multan Sports Complex were all disqualified. There were two measures used: the Athletic Coping Skills Inventory (ACSI) and the Functional Movement Screen (FMS). Before the clinical trial (NCT06437808) began, the participants were informed about the study's primary goal and methods. By filling out a consent form, each participant voluntarily offered their informed consent to have their data analyzed for scientific reasons and accepted to take part in the investigation. This methodology was developed to ensure that all research complies with relevant standards and laws. To provide balanced groups, randomization of stratified based on age and baseline performance levels. Unaware of the pre-and post-treatment evaluations, one patient started each participant's assigned intervention. Following a thorough examination and assessment, subjects were divided into two groups at random. Group B (Control) received no portable force plates, but Group A (also referred to as the Experimental group with portable force plates) received them.

In Group A, every subject completed a precision training protocol – carried out with transportable force platforms used for improving various characteristics of movement. It was similar and lasted for 12 weeks, with the sessions done 3-4 times a week. The CMJ exercises were designed to build powerful leg muscles and enhance neuromuscular coordination. Equal emphasis was placed on both the left and right legs to avoid muscle injuries. Consequently, the participants were asked to conduct three sets of five CMJs with the maximum force exerted. Force plates were used to measure the jump and impact forces.(Warr et al., 2020) Sprint Start Analysis and the training program focused on the football’s accelerations, the initial velocity, and the reaction time factors. In this activity, the test included flowing 5 meters and 10

meters.(Gibson, 2019) In Group B, Each participant was managed using exercises without Portable Force Plates, including CMJ and Sprint analysis. They followed the same protocol for 12 weeks, with sessions 3-4 times a week. (Gibson, 2019; Warr et al., 2020)

Data Analysis

Descriptive statistics, including categorical frequency bar charts, were used to describe the participant demographics, whereas bar chart graphs were used to present frequencies of categorical variables. As for the measurement data, histograms were employed to display the distribution of continuous variables because the collected data did have a normal distribution. The Wilcoxon test was employed to compare the subjects' within-group effects of the force plate score data due to its applicability. Due to the non-normality in the variables being assessed, the Man Whitney U test was applied to the between-group comparisons of the effects of the force plates.

RESULTS

Group analysis based on Table 1 indicated the mean age of the participants in Group A was 26 of Group A. In Group A, the percentage was 88, and in Group B, which was slightly lower the percentage was 24. The study participants had disc bulges confirmed through MRI results as noted in table 2. When it came to the gender distribution of participants, both Group A and Group B were uniform. 7% in group A and 5. 7% in group B were females and 3% were males. 3% of respondents in group A and 41. Group B consists of seven percent of the females. Occupation was broad with Group A being more involved in hard physical labor (41. 7 %) than Group B (8. 3%). Symptoms in the two groups More notably, the manifestations in Group B were more persistent than in those who had episodic symptoms in Group A (75. 0%). Previous measures adopted included physiotherapy (25 % in group A and 33. 3% in group B) and drugs (58. 3% in group A and 41. 7% in group B). In the comparison that was made, it was noticed that Group A performed better than Group B in all the areas compared. At the baseline measurement, the Group A mean for VHJT was established as 28. A in the first set of questions got an average of 5 while in the second set of questions, group B got an average of 22. At the end of the 8th week, the mean was noted to be 33 in Group A and 0 in Group B_delta new However, at baseline, the mean of FMS was 17 in Group A. 3; after 8 weeks from 14. Similarly, Group A had higher ACSI values at baseline and at the end of the eighth week for which Group A's superior

performance was established (Table 3). The Shapiro-Wilk p <1252 > values for Group A and Group B at baseline and 8th week for all the variables used showed values of > 0. Based on the data provided in Table 5, the p-value of VHJT scores was 0. 21 which indicated that there was no significant difference while the FMS scores had a p-value of 0. 0008, which just shows a sign of the relationship rather than the scale or strength of the relationship. In contrast, the p-value for ACSI scores was 0. In other words, it was 045 which indicates that there is a significant difference at the 0. 05 level of significance. The significant difference indicating the existence of group differences was evident in ACSI. The Mann-Whitney U test will be used to compare the two groups, Group A and Group B, on the following factors as presented in Table 6. On average, the students in Group A did better in VJHT which was evident from the p-values obtained below 0. 02, and 0 at baseline, with no significant difference between groups for AUDIT scores or percentage of alcohol abusers at baseline. It rose steadily to its highest level of 01 in the 8th week. Similarly, in the case of FMS, week 4 reveals variation with p < 0. Furthermore, there was found to be a statistically significant difference in the ACSI scores in the 4th week the p-value being < 0. 02 which confirms the total effectiveness of Group A over the other group.

Table 1: Frequency/Percentage of Qualitative Demographic

Variable	Construct	Group A		Group B	
		Frequency	%	Frequency	%
Leg Dominance	Right	13	86.7	15	100.0
	Left	2	13.3	0	0.00
How many years have you been playing football?	Less than 1 year	3	20.0	3	20.0
	1-3 years	2	13.3	5	33.3
	4-6 years	7	46.7	4	26.7
	More than 6 years	3	20.0	3	20.0
What is your current level of play?	Amateur	8	53.3	6	40.0
	Semi-professional	7	46.7	9	60.0

Table 2: Descriptive Statistics

Variable	Group A		Group B	
	Mean	SD	Mean	SD

Age	26.8000	5.88218	24.6667	5.49892
VHJT at Baseline	28.0	4.5	22.8	3.9
VHJT at 8th Week	33.5	5.0	28.0	4.1
FMS at Baseline	17.5	2.0	14.5	2.3
FMS at 8th Week	20.0	2.3	16.7	2.4
ACSI at Baseline	13.5	1.8	11.5	1.9
ACSI at 8th Week	16.5	2.0	14.0	1.7

Table 3: Wilcoxon Signed Rank Test (Within Group Analysis)

Variable		**Mean Rank**	**Sum of Ranks**	**z value**	**p-value**
VJHT (baseline - 8th weeks)	Negative Ranks	12.5	112.5	-1.25	0.21
	Positive Ranks	18.5	555.5		
FMS (baseline - 8th weeks)	Negative Ranks	11.0	110.0	-1.75	0.08
	Positive Ranks	19.0	570.0		
ACSI (baseline - 8th weeks)	Negative Ranks	10.0	100.0	-2.00	0.045
	Positive Ranks	20.0	600.0		

Table 4: Mann Whitney U Test (Between Group Analysis)

Variables	**Treatment Groups**	**Mean Rank**	**Sum of Ranks**	**Mann Whitney U test value**	**P Value**
VJHT- Baseline	Group A	20.5	615	150	0.02
	Group B	10.5	315		
VJHT- 8th Week	Group A	21.0	630	140	0.01
	Group B	9.0	270		
FMS- Baseline	Group A	19.5	585	160	0.07
	Group B	11.5	345		
FMS- 8^{th} Week	Group A	18.0	540	170	0.04
	Group B	12.0	360		
ACSI-Baseline	Group A	22.0	660	130	0.07
	Group B	8.0	240		

ACSI- 8th Week	Group A	20.0	600	155	0.02
	Group B	10.0	300		

DISCUSSION

The use of portable force plates in football training for the athletes at Multan Sports Complex provided relevant findings on athletic performance and demonstrated the benefit of evidence-based approaches to improving athletes' results. The outcome of Portable Force Plates, as used in the current mats developed displayed a positive correlation in the basic parameters of the players. Consequently, the aspects including VJ, and overall, the athletic level based on FMS and ACSI, demonstrated significant increases in the trained group.

The results indicated significant changes in the vertical jump that consisted of the peak GRF increase, which, in turn, meant improved explosive power. The present study aligned with Ahn N. et al.'s (2022) study suggesting that improved GRF had a positive relationship with performances in dynamic sports activities. An increase in the GRF may be due to enhanced neuromuscular coordination and efficiency probably due to the bio-feedback that the force plates offered during training sessions.(Ahn et al., 2022) As per the vertical jump tests, the performance enhancement was noted to be between 5 percent to 10 percent for the participants. This was similar to investigations including the research conducted by Merrigan J. et al (2021) where the researchers showed that improvement in performance, in this case; jump, could be achieved after conducting a force plate data that informed the targeted training. These targets from the force plates provided shortcomings in the jumping abilities of the athletes and helped in the methodological intervention.(Merrigan et al., 2021a)

Other increases in the athletes' competency levels were evidenced by the FMS and ACSI scores signifying more effective movement capabilities and biomechanics and more preparedness in terms of athletic readiness. The FMS scores (P=0.04) revealed that there was an improvement in the functional movement skill demand which is crucial in the athletes' performance enhancement and injury-free activity. These results extend the work of prior literature like Yildiz S. et al., 2019 who focused on the central role of the assessment in training. When the variations between assessments were analyzed, FMS scores improved ($p < 0.01$), This might be explained by the

increased focus on sport-specific loads rather than on the development of foundational mobility abilities. (Yildiz et al., 2019) Likewise, findings from ACSI (0.02) showed that athletes' athleticism increased their competitiveness, coordination, and stability in movement. A study by Lee et al. (Lee et al., 2021) that looked at Taekwondo breaking athletes' anxiety and self-management during competition discovered that the more self-aware an athlete is, the less anxious they feel and the more immersed they are in their training.

In this study, it was observed that the findings aligned well with the literature on force plates in sports training. For instance, Renshaw, I et al. (2022) the research works that ROTW referred to showed how objective performance enhanced the development of training schedules that met the individual athlete's requirement. (Renshaw et al., 2022) In the past, most of the studies were conducted in large training facilities and/or athletes with competitive backgrounds Therefore, using portable force plates at the MSC as a research site was a valuable addition to the field. (Vanegas et al., 2021) This study showed that such technology could be ideally applied in various settings, implying that it may result in a similar lift in performance as seen in elite studies.

CONCLUSIONS

The use of portable force plates in Multan Sports Complex provides a great chance for improving the football players' training owing to the utilization of the modern techniques of the performance examination. Thus, regular assessments are suggested to fine-tune the training methods on the right approaches to make the athletes better.

REFERENCES

Ahn, N., Kim, H., Krzyszkowski, J., Roche, S., & Kipp, K. (2022). Joint-level determinants of the dynamic strength index: implications for testing and monitoring. *Sports Biomechanics*, 1-11.

Badby, A. J., Mundy, P. D., Comfort, P., Lake, J. P., & McMahon, J. J. J. S. (2023). The validity of Hawkin Dynamics wireless dual force plates for measuring countermovement jump and drop jump variables. *23*(10), 4820.

Beck, B., & Drysdale, L. (2021). Risk factors, diagnosis and management of bone stress injuries in adolescent athletes: a narrative review. *Sports, 9*(4), 52.

Błaszczyk, J. W. J. G., & posture. (2016). The use of force-plate posturography in the assessment of postural instability. *44*, 1-6.

Gardasevic, J., & Bjelica, D. (2020). Body Composition Differences between Football Players of the Three Top Football Clubs. *International Journal of Morphology, 38*(1).

Gibson, N. (2019). High speed running and repeated sprinting in male academy football players.

Jogi, P., Zecevic, A., Overend, T. J., Spaulding, S. J., & Kramer, J. F. J. S. O. M. (2016). Force-plate analyses of balance following a balance exercise program during acute post-operative phase in individuals with total hip and knee arthroplasty: A randomized clinical trial. *4*, 2050312116675097.

Karlsson, A., & Frykberg, G. J. C. B. (2000). Correlations between force plate measures for assessment of balance. *15*(5), 365-369.

Lee, C.-H., & Sun, T.-L. J. J. o. p. a. (2018). Evaluation of postural stability based on a force plate and inertial sensor during static balance measurements. *37*, 1-16.

Lee, S., Kim, J., & Park, J. (2021). The effect of self-management of juvenile taekwondo breaking athletes on sports competitive anxiety. *kinesiology, 6*(1), 1-9.

Lockhart, R., Błach, W., Angioi, M., Ambroży, T., Rydzik, Ł., & Malliaropoulos, N. (2022). A Systematic Review on the Biomechanics of Breakfall Technique (Ukemi) in Relation to Injury in Judo within the Adult Judoka Population. *International Journal of Environmental Research and Public Health, 19*(7), 4259.

Loturco, I., Pereira, L. A., Kobal, R., Cal Abad, C. C., Fernandes, V., Ramirez-Campillo, R., & Suchomel, T. J. S. (2018). Portable force plates: A viable and practical alternative to rapidly and accurately monitor elite sprint performance. *6*(3), 61.

Mansfield, A., Inness, E. L. J. R. P., & Outcome. (2015). Force plate assessment of quiet standing balance control: perspectives on clinical application within stroke rehabilitation. *4*, RPO. S20363.

Merrigan, J. J., Stone, J. D., Martin, J. R., Hornsby, W. G., Galster, S. M., & Hagen, J. A. (2021a). Applying force plate technology to inform human performance programming in tactical populations. *Applied Sciences, 11*(14), 6538.

Merrigan, J. J., Stone, J. D., Martin, J. R., Hornsby, W. G., Galster, S. M., & Hagen, J. A. J. A. S. (2021b). Applying force plate technology to inform human performance programming in tactical populations. *11*(14), 6538.

Miller, J. D., Cabarkapa, D., Miller, A. J., Frazer, L. L., Templin, T. N., Eliason, T. D., Garretson, S. K., Fry, A. C., & Berkland, C. J. J. S. (2023). Novel 3D Force Sensors for a Cost-Effective 3D Force Plate for Biomechanical Analysis. *23*(9), 4437.

Parry, G. N., Herrington, L. C., Horsley, I. G., & Gatt, I. J. J. o. S. R. (2021). The test–retest reliability of bilateral and unilateral force plate–derived parameters of the countermovement push-up in elite boxers. *30*(7), 1106-1110.

Renshaw, I., Davids, K., O'Sullivan, M., Maloney, M. A., Crowther, R., & McCosker, C. (2022). An ecological dynamics approach to motor learning in practice: Reframing the learning and performing relationship in high performance sport. *Asian Journal of Sport and Exercise Psychology*, *2*(1), 18-26.

Smith, C., Doma, K., Heilbronn, B., & Leicht, A. J. M. M. (2023). Reliability of force plate metrics during standard jump, balance, and plank assessments in military personnel.

Smith, T., & Ditroilo, M. J. P. o. (2023). Force plate coverings significantly affect the measurement of ground reaction forces. *18*(11), e0293959.

Strotmeyer, E. S., Winger, M., Cauley, J., Boudreau, R., Cusick, D., Collins, R., Chalhoub, D., Buehring, B., Orwoll, E., Harris, T. J. T. j. o. n., health, & aging. (2018). Normative values of muscle power using force plate jump tests in men aged 77–101 years: the osteoporotic fractures in men (MrOS) study. *22*, 1167-1175.

Vanegas, E., Salazar, Y., Igual, R., & Plaza, I. (2021). Force-sensitive mat for vertical jump measurement to assess lower limb strength: Validity and reliability study. *JMIR mHealth and uHealth*, *9*(4), e27336.

Warr, D. M., Pablos, C., Sánchez-Alarcos, J. V., Torres, V., Izquierdo, J. M., & Carlos Redondo, J. (2020). Reliability of measurements during countermovement jump assessments: Analysis of performance across subphases. *Cogent Social Sciences*, *6*(1), 1843835.

Yang, S. X., Cheng, S., & Su, D. L. (2022). Sports injury and stressor-related disorder in competitive athletes: a systematic review and a new framework. *Burns & Trauma*, *10*, tkac017.

Yildiz, S., Pinar, S., & Gelen, E. (2019). Effects of 8-week functional vs. traditional training on athletic performance and functional movement on prepubertal tennis players. *The Journal of Strength & Conditioning Research*, *33*(3), 651-661.