Effects of a 12-Week Physical Education Intervention Programme on Physical and Motor Fitness of Grade 7 Learners in Potchefstroom, South Africa

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Abstract

This study aimed at evaluating the effects of an enhanced quality Physical Education (PE) programme on the physical and motor fitness levels of South African Grade 7 learners. Using a pre-test and post-test control-group design, 110 Grade 7 learners aged 12-13 years (experimental school, n = 40; control schools, n = 70) from two primary schools in Potchefstroom, South Africa, were studied. They participated in a 12-week PE intervention programme based on the South African Curriculum and Assessment Policy Statement (CAPS) which allocates one hour per week to teaching PE. The intervention included 5 quality-enhancing components namely well-trained teachers, homework activities, a reward system, improvised apparatus and the monitoring of activity intensity. In the experimental school, 4 experimental sub-groups of 10 learners each were formed. Other categories included two control groups (n = 37 and n = 33), one from the same school as the experimental school, and one from a different school. Physical and motor fitness levels were assessed using the Eurofit test battery. An analysis of covariance (ANCOVA) was used to examine between and within the group differences as well as the effects of the intervention programme. Effect sizes (ES) were calculated to evaluate practical significance. The co-variance analysis of learners' data after the 12 weeks intervention programme showed statistically significant improvements of varying degrees among most of the experimental groups with regard to the test results for sit and reach (ES=0.4, p=0.000), standing broad jump (ES=0.13, p=0.014), sit-ups (ES=0.39, p=0.000), shuttle run test for aerobic fitness (ES=0.14, p=0.007), plate tapping (ES=0.23, p=0.000), and shuttle run for agility (ES=0.28, p=0.000). The differences between the combined control and experimental groups regarding these tests also yielded practically and statistically significant differences (ES> 0.13; p<0.05), while no substantial differences were found in the control groups. It is concluded that the enhanced quality PE programme used in this study appears to be effective in improving physical and motor fitness among South African primary schoolchildren.

Keywords: *Physical Education intervention, physical fitness, motor fitness, children.*

1. Introduction

Physical and motor fitness are important indicators of physical and psychological health in youth (Eather *et al*., 2013). The components of physical fitness (PF) are generally considered to be body composition, cardiovascular endurance, flexibility, strength and muscular endurance (Ortega *et al*., 2008; Haga, 2009), while motor fitness components are speed, balance, coordination, agility and explosive power (Voelcker Rehage *et al*., 2010; Sacchetti *et al*., 2012). Maintaining and ensuring PF has shown strong negative correlations with overweight and obesity as well as cardiovascular disease risk factors (Parfitt *et al*., 2009), and are associated with mental health and academic achievement in children and adults (Voelcker-Rehage *et al*., 2010; Christodoulos *et al*., 2006). In addition, several studies (Stratton *et al*., 2007; Pienaar & Kemp, 2009; Eather *et al*., 2013) demonstrate that children's fitness levels tend to decline, while fatness levels are

inclined to increase with age.

Due to the relationship of overweight, obesity and other variables with PF, investigations into the factors influencing PF have increased in recent years (Sacchetti *et al*., 2012). Castelli and Valley (2007) examined the effects of PF and motor competency on the physical activity (PA) levels of 230 children aged 7-12 years old in American Midwest and reported that children presented medium or low PA levels and a lack of motor competence. Similar findings have also been reported by Carter and Micheli (2013) who indicated that the aerobic fitness levels of American children and adolescents are decreasing. One study by Tomkinson *et al*. (2003) which examined trends in aerobic fitness among 12-15 year-old South Australian schoolchildren, reported that there had been a significant annual decline in PF levels among these children. In relation to children of similar ages in other countries, Australian children showed poor to average aerobic fitness levels (Tomkinson *et al*., 2003).

In South Africa, a study by De Milander (2011) which investigated the motor proficiency and PF levels of 97 girls aged 12-13 years in Bloemfontein indicated that the majority of the girls had insufficient fitness levels. These findings support those of Lennox *et al*. (2008) who evaluated the PF and PA status of 15-year-old South African adolescents in the North West Province, and found low fitness and PA levels among the children. Similar results were reported in another South African study by Toriola and Monyeki (2012) which evaluated the health-related PF, body composition and PA status of 14 year-old South African adolescents in the North West Province.

Concern about the decline in children's fitness levels in many countries has prompted the need to design appropriate intervention programmes in order to reverse the trend. For instance, in their study of 10 year-old Australian children in Newcastle, Eather *et al*. (2013) evaluated the impact of a 6-month, 60 minutes per week multi-component school-based PA intervention programme, incorporated with homework and break-time activities, on the children's health-related fitness. The authors concluded that the children's PA levels and fitness especially, muscular fitness and flexibility significantly improved after the intervention. Similarly, Zhou *et al*. (2014) using a quasi-experimental design, investigated the effectiveness of a 12-month multifaceted intervention programme, including the incorporation of family and community involvement, to promote the PF levels of 357 Chinese preschool children in Beijing. The results demonstrated that such a multi-faceted intervention programme can successfully improve preschool children's body composition and PF. In a study conducted in Potchefstroom, North West Province of South Africa, Pienaar *et al*. (2013) designed a PA, diet, and behaviour modification intervention programme to improve the body composition and PF of 11 year-old children. It was concluded that the intervention programme had a significant beneficial impact on the learners' body composition profiles and health-related PF levels such as muscular strength and flexibility. Another comparable study indicated that adolescents in disadvantaged communities of the North West Province showed significant improvements in aerobic fitness levels and motor skills after an extra-mural aerobic intervention programme carried out twice a week for 60 minutes per session (Lennox & Pienaar, 2013).

The low PF and PA levels of South African children as well as research results regarding the effect of intervention programmes were motivating factors for the reintroduction of PE in the South African school curriculum, after an absence of more than ten years (Du Toit *et al*., 2007:241). However, PE has been allocated only one hour per week in the school time table (DBE, 2011:7), which is inadequate to improve the PF of children and adolescents when compared to international guidelines that youth should participate daily in at least 60 minutes of moderate to vigorous intensity PA (ACSM, 2009:3; WHO, 2009).

In addition to the limited time allocation for PE, the quality of PE in South African schools has been compromised by other challenges resulting from its long absence from the curriculum, including poor teacher preparation, inadequate resource allocation and its low status as a subject (Van Deventer; 2012:162; Du Toit *et al.*; 2007:241).

In the light of the above background, the question arises as to whether an enhanced quality PE programme, presented by well-trained PE teachers and incorporating initiatives like PE homework and creative rewards, can have a profound effect on children's physical and motor fitness levels. Therefore, the present study was designed to evaluate the effects of an enhanced quality PE programme on the physical and motor fitness levels of South African Grade 7 learners.

2. Methods

2.1 Research design

An experimental study was conducted using a pre-test and post-test control-group design in which the dependent variables were measured before and after intervention.

Participants were assigned to experimental and control groups. The experimental groups participated in a 12-week enhanced quality PE programme presented by well-trained PE teachers, based on the guidelines of the South African

Curriculum and Assessment Policy Statement (CAPS) (DBE, 2011). The control groups attended the usual PE classes taught by teachers who had had the usual governmental training after the reintroduction of PE, consisting of one afternoon's training in presenting PE. Physical and motor fitness levels were assessed before and after the intervention.

2.2 Participants

A convenient sample of 110 Grade 7 learners (experimental groups, *n* = 40; control groups, *n* = 70, aged 12-13 years) from two primary schools in Potchefstroom, the capital city of the North West Province in South Africa, participated in this study. Learners in the two schools had similar socio-economic backgrounds and were representative of the demographic composition of the Potchefstroom area. Although both schools had large open fields, no apparatus were available for PE lessons at the schools. In one school, 4 experimental sub-groups of 10 learners each were formed to control for possible teacher-interactive effect. As there were only ten boys among the 40 learners and in order to compare the experimental groups more accurately, it was decided to place all the boys in one of the four experimental groups. Two control groups, one from the same school (*n* = 37) as the experimental groups and one from a different school (*n* = 33) were used.

2.3 Measuring instruments

2.3.1 Anthropometric assessments

The anthropometric measurements which included body weight, stature, BMI and body fat percentage were performed according to the guidelines of the International Society for The Advancement of Kinanthropometry (ISAK, 2001). Body weight was measured on a portable electronic scale to the nearest 0.1 kg. Participants wore minimal clothing and took off their shoes before the weight measurement. BMI was calculated as weight (kg)/height (m^2). Height was measured with a stadiometer and recorded to the nearest 0.1 cm. Percentage body fat was calculated from triceps and subscapular skinfolds measurements using the equation of Slaughter *et al*. (1988), which was age- and sex-specific.

2.3.2 Physical and motor fitness assessments

The EUROFIT (EUROFIT, 1988) test battery was used for the fitness measurements. It comprises nine tests measuring cardio-respiratory endurance, muscle strength, muscular endurance, flexibility, running speed, agility, and balance. For the purpose of the study the participants performed the following fitness tests:

20-meter multistage shuttle run - This aerobic fitness test required participants to step over markers located at a 20-metre distance simultaneously with a bleep signal until they were unable to keep up with the running pace.

Sit-ups - The number of sit-ups that learners were able to perform in 30 seconds was used to measure functional abdominal strength.

Sit and reach - Flexibility was measured with a sit and reach test. The participants reached forward over a measuring bar while seated bare feet and legs kept straight (knees fully extended) against a sit and reach box. The distance reached by the distal tips of the fingers, following forward inclination of the trunk was recorded to the nearest 0.1cm.

Flamingo balance - The flamingo balance test was assessed on a 3 cm wide balance beam. The participants were required to stand on the balance beam with their preferred leg and the number of attempts in one minute was recorded.

Standing broad jump - The test evaluated the explosive power of the lower body and leg extensors. The distance the participants jumped a two-legged take off was measured and recorded to the nearest 0.01m.

Plate tapping - This test required the learners to perform taps with one hand on a rectangular plate and two round discs. They moved the preferred hand back and forth between the discs over the center hand. The time taken to complete 25 cycles was recorded.

Shuttle run 10 x 5 meters - Agility and running speed were assessed with a 10x5 m shuttle run test in which participants tried to touch each marker 5 times over a 5-metre distance. The total time taken was recorded.

Bent arm hang – This test evaluated upper body muscular endurance. Participants were assisted to the height of a horizontal bar with the chin at the level of the bar. The total time that the participant held this position to exhaustion was recorded.

2.4 The enhanced quality Physical Education programme

The enhanced quality PE programme was presented for 60 minutes once a week over 12 weeks, as prescribed in the PE curriculum guidelines suggested in the CAPS (DBE, 2011). According to the CAPS (DBE, 2011), PAs for the first semester of Grade 7 entails various PF activities (weeks 1 to 6) and indigenous games (weeks 7-12). Each lesson in the PE intervention programme comprised a 10-minute warm-up and introduction, followed by a 50- minute activity session which consisted of 30 minutes of moderate to high intensity aerobic exercise (such as rope skipping, aerobic dance, throwing Jukskei, and playing soccer), and 20 minutes of strength and muscular endurance activities (like sit-ups, crab soccer, ball dribbling, and wheelbarrow exercises). Additionally, awards comprising stickers for class participation and completed homework as well as new homework were given at the end of each lesson. The compliance of learners to the programme was ensured by the marks awarding system, prescribed by the CAPS, whereby a learner attained a mark for every PE lesson that he/she participated in (DBE, 2011).

To optimize the quality of the PE programme within this framework and within the circumstances at the schools as described above, emphasis was placed on five components, namely using well-trained PE teachers, including homework activities, a reward system, improvised apparatus, and monitoring of the intensity of activities.

2.4.1 Well-trained PE teachers

The PE intervention programme offered to the experimental groups was presented by four pre-service PE teachers who have had 3 years of teacher training in a B.Ed PE degree programme (NWU, 2013). The B.Ed degree programme included in-depth training on skills required in the following specific areas: ability to differentiate learners with unique learning styles, physical abilities and developmental levels and adapting PE activities accordingly; using various PE teaching styles; incorporating in-depth knowledge of exercise and sport physiology into the PE programme, using effective organisational and discipline skills in presenting practical activities; and implementing accurate and effective assessment of movement skills and abilities (NWU, 2013). In the control groups, the normal PE programme was presented by PE teachers who had undergone one afternoon's PE teacher preparation programme presented by the North West Department of Education (Crouse, 2013). This is a crash teacher training programme designed in response to the urgent need created by the reintroduction of PE in the school curriculum.

2.4.2 Homework activities

Specific homework activities were given to learners to encourage them to be physically active after school and during their free time. These homework activities were follow-up activities of those presented during the PE lesson, but which always included aerobic exercise, even when practicing a sport skill. For example, when the PE lesson included the skill of dribbling a soccer ball, the homework activity would be to dribble the ball around obstacles placed in a line over a distance of 20 meters, and the learner would have to attempt to complete as many 20-meter sets successfully as possible in 5 minutes, and then repeat the exercise at least four times. The signatures of the learners' parents, confirming their compliance, were required and the learners were asked to show the homework to the teacher at subsequent classes, which also formed part of the warm-up activity for such lessons.

2.4.3 Reward system

Rewards included stickers, badges and certificates, and colourful self-evaluation and motivational charts, which were all made at minimum cost from recycled paper by the researchers. At the beginning of the intervention programme, learners received colourful booklets in which they received stickers for participation in lessons as well as completed homework (showing the activities that had been practiced at home). Learners who had a certain number of stickers in their homework booklets within the first 6 weeks were awarded colourful badges. After finishing the programme and on completion of the fitness tests, the learners received certificates of acknowledgement.

2.4.4 Improvised apparatus

As the school did not have standard PE apparatus, improvised equipment were made from waste material, for example, balls were made from crumpled newspaper and tape. These supplies were then taken home by the learners for their homework activities.

2.4.5 Monitoring intensity of activities

The intensity of the aerobic activities during the PE lesson and homework activities was monitored by asking learners to measure their own heart rate at 5-minute intervals by using the manual palpation method to feel the carotid pulse (neck) or the radial pulse (wrist) and counting their heartbeat for ten seconds under the guidance and supervision of the teacher. Activities were then adapted (made faster or slower) so that learners' heart rates stayed within the recommended heart rate range for cardiorespiratory improvement; calculated as 60% - 80% of the estimated maximal heart rate (220-age) (ACSM, 2009). Therefore, the children's exercise heart rates ranged between 124 and 166 beats per minute throughout the intervention programme.

2.5 Ethical considerations

Ethical approval for the study was obtained from the Ethics Committee of the North West University (Ethics approval no: NWU-00003-14-S1). Permission was also obtained from the school principals as well as the North West Department of Education. Written informed consent was obtained from learners' parents before they participated in the study.

2.6 Procedures

Baseline and post-intervention assessments were performed on the school premises by the researcher, with the assistance of fourth-year pre-service PE teachers, who were well-trained in the implementation of the EUROFIT test battery.

2.7 Data Analysis

Data were analyzed using SPSS version 21 software. The descriptive characteristics were expressed as means and standard deviations. The comparisons between the experimental and control groups at the baseline measurements were evaluated with a series of analysis of covariance (ANCOVA). In the ANCOVA, adjusted means were computed with the pre-test data as co-variates to determine the effects of the intervention programme. Tukey's post hoc analysis was used to statistically interpret significant group differences. To examine the practical significance of differences, the results were analysed as recommended by Steyn (2006). In this regard, Steyn (2006) proposed that a correlation coefficient of 0.1 represents a small effect, 0.2 a medium effect and 0.5 a large effect. For all statistical analyses a probability level of 0.05 or less was taken to indicate significance.

3. Results

The baseline descriptive statistics of the children's anthropometric characteristics and the fitness results for the control and the experimental groups are presented in Table 1. With regard to anthropometric characteristics, only height differed significantly among all the experimental and control groups (p=0.030), while non-significant group differences were found in body weight, BMI and percentage body fat (p=0.199, 0.078 and 0.065, respectively). The Tukey's HSD results for height showed that the significant difference was observed between experimental group 3 and control group 2, with learners in the control group 2 having higher mean values than those in experimental group 3. Regarding the fitness measurements, four of the eight fitness parameters showed statistically significant differences among the control and experimental groups as well as among the experimental groups, which were plate tapping (p=0.000), sit and reach (p=0.001), the 10x5 meter shuttle run (p=0.000) and the 20m meter shuttle run (p=0.000) tests. The Tukey's post hoc analysis showed that learners in experimental group 3 performed significantly poorer than the other groups regarding the plate tapping test. As for the sit and reach test, learners in experimental group 1 performed significantly worse than those in experimental group 2. Considering the 10x5 meter shuttle run test, experimental group 1 had significantly higher mean values compared with the other groups. Significant differences were found in the 20m meter shuttle run test among experimental groups 1, 2 and 3. Further analysis indicated that learners in experimental group 1 performed significantly better than those in experimental groups 2 and 3 (Table 1). However, the flamingo balance, standing long jump and bent arm hang tests did not yield any significant differences among the groups. Generally, experimental group 1 had the highest mean values for all the fitness measurements when compared to the other 3 experimental groups, which might be attributed to gender differences as this was the only boys' group.

Table 1: Descriptive statistics of control and experimental groups at baseline (Mean ± SD)

Variables	Control Group		Experimental Group				*p* value
	Group1 (n=37)	Group2 (n=33)	Group1 (n=10)	Group2 (n=10)	Group3 (n=10)	Group4 (n=10)	
Height (cm)	152.7±7.9	156.5±6	1.54±5.1	154.1±7.3	148.4±7.4	150.3±7.4	0.030*
Weight (kg)	49.7±11.2	47.8±10.5	52.6±12.7	52.5±10.8	48±10.5	53.3±9.7	0.199
BMI (kg.m^{-2})	20.8±4.35	19±4.1	21.5±4.1	22.0±4.2	21.8±4	23.1±3.7	0.078
%Body fat	20.7±5.7	20.3±7.1	19.6±4.6	22±1.9	20.3±4.8	22.2±1.0	0.065
Flamingo balance (attempts)	3.1±2.9	4.3±3.1	2.6±2.1	4.2±3.5	3.7±2.6	2±1.7	0.232
Plate tapping (sec.)	12.7±1.1	12.7±1.6	14.2±2.7	12.4±0.8	15.4±1.7	12.8±0.6	0.000*
Sit and reach (cm)	42±6.1	38.1±8.3	33.6±5.3	43±6.1	38.1±2.8	36.3±9.4	0.001*
Standing broad jump (m)	1.33±0.2	1.22±0.3	1.51±0.1	1.38±0.2	1.31±0.1	1.47±0.2	0.618
Sit-ups (reps)	12±6.1	12.8±5.5	10.4±1.6	7.8±4.3	7.8±3.1	11.2±3	0.182
Bent arm hang (sec.)	6.5±2.2	8.8±3.3	11.6±4.1	4.3±3	7.3±6.3	3.1±1.5	0.192
10x5 meter run (sec.)	21.5±2.3	22.6±3.9	21.3±2	24.7±1.5	23.8±2.6	22.3±1.4	0.000*
20m shuttle run (laps)	3.1±1.5	3.7±1.6	4.7±1.3	1.5±0.7	2.3±0.5	3±1	0.000*

*P < 0.05; BMI = body mass index

Adjustments were made for the above pre-test differences, after which the intervention effect was determined by means of a series of ANCOVA with the pre-test data used as co-variates. The results are shown in Tables 2 and 3, respectively.

Table 2: Adjusted post-test means for experimental and control groups

Variables	Control Groups		Experimental Groups				*ES*	*p*
	Group1 (n=37)	Group2 (n=33)	Group 1 (n=10)	Group 2 (n=10)	Group 3 (n=10)	Group 4 (n=10)		
Height (cm)	155.7	158.3	157.2	156.0	150.0	151.9	0.03	0.615
Weight (kg)	50.9	50.4	52.0	52.4	50.1	52.6	0.09	0.520
BMI (kg.m^{-2})	20.5	20.1	20.9	21.6	21.3	22.8	0.03	0.590
%Body fat	21.7	20.7	19.1	21.9	19.9	22.8	0.13	0.309
Flamingo balance (attempts)	4.3	2.4	4.3	2.2	3.0	1.9	0.12[a]	0.204
Plate tapping (sec.)	12.2	11.6	10.5	11.9	13.3	12.1	0.23[b]	0.000*
Sit and reach (cm)	40.9	39.7	39.0	45.9	47.0	47.7	0.40[b]	0.000*
Standing broad jump (m)	1.39	1.52	1.41	1.38	1.35	1.44	0.13[a]	0.014*
Sit-ups (reps)	13.3	10.4	19.8	12.3	10.0	16.1	0.39[b]	0.000*
Bent arm hang (sec.)	8.4	6.6	8.4	6.4	6.9	7.0	0.04	0.477
10x5 meter run (sec.)	22.1	21.3	15.0	23.7	22.6	20.3	0.28[b]	0.000*
20m shuttle run (laps)	3.4	3.2	4.8	4.1	4.2	4.1	0.14[a]	0.007*

M=Adjusted mean; ES=Effect size ; *P < 0.05; small≥0.1[a], medium≥0.2[b], large≥0.5[c];BMI = Body Mass Index

The ANCOVA revealed that the intervention programme resulted in significant group differences on all the fitness measurements except for bent arm hang and flamingo balance, indicating positive effects of the enhanced quality PE intervention programme. The post hoc pairwise comparisons indicated that experimental group 1 performed significantly poorer than the other three experimental groups regarding the sit and reach test. Furthermore, the improved scores in experimental groups 1, 3 and 4 showed substantial significances between pre- and post-test measurements, with practical significance of medium and large effects (ES= 0.28, 0.35 and 0.60). Experimental group 4 exhibited the highest mean values among the three experimental groups (31.4%), whereas no substantial changes were found in the control groups (Table 3). For the standing broad jump test, control group 2 performed significantly better than the other groups. However, the mean score of experimental group 4 was significantly increased between pre- and post-test measurements with practical significance of a large effect (ES= 0.70), while no changes were found in the other groups. With regard to the sit-up tests, experimental group 1 performed significantly better than the other groups. Results also indicated statistically significant increases in the experimental groups 1 and 4 between pre- and post-test measurements, which reflected large practical significance effects (ES= 0.60 and 0.53, respectively). It is striking to note that the highest improvement in mean score was noted in experimental group 1 (90.3%) in comparison to experimental group 4 (57.6%). Regarding the 20m shuttle run test, the intervention programme contributed to significant group differences among control groups 1 and 2 and experimental group 1, which also seemed to have resulted in marked improvements in

experimental groups 2, 3 and 4 between pre- and post-test measurements, with practical significance of large effects (ES= 0.50, 0.70 and 0.55). In this regard, experimental group 3 had the highest increase among the three experimental groups (82.6%). Considering the plate tapping and 10x5m shuttle run tests, significant group differences were observed between experimental category 1 and the other groups, and experimental group 1 performed the best compared with the other groups. Moreover, significant increases were also found between the pre- and post-test scores of the two tests of experimental group 1, which reflected large practical significance effects (ES= 0.50 and 0.51, respectively).

Although this study did not aim to combine the control groups and experimental groups into two groups due to the differences in schools and teachers, it can be noted that the average adjusted pre- and post-test scores of all the experimental groups combined, also showed statistically significant differences in the same tests as describes above, namely the sit and reach (ES=0.23), standing broad jump (ES=0.13), sit-ups (ES=0.18), 20m shuttle run test (ES=0.23), plate tapping (ES=0.50) and 10 x 5m shuttle run (ES=0.28) tests. No significant differences were found in the pre- and post-test scores of the combined scores of the control groups.

Table 3: Summary of statistical significant improvements, effect sizes and percentages of improvement of the experimental and control groups after adjustment by ANCOVA

Variables	Control Groups						Experimental Groups											
	Con 1			Con 2			Exp 1			Exp 2			Exp 3			Exp 4		
	p	Per	ES	*p*	Per	ES	*p*	Per	ES	*p*	Per	ES	*p*	Per	ES	*p*	Per	ES
Plate tapping (sec.)	-	-	-	-	-	-	0.009*	8.69%	0.52[c]	-	-	-	-	-	-	-	-	-
Sit and reach (cm)	-	-	-	-	-	-	0.05*	16%	0.28[b]	-	-	-	0.005*	23.3%	0.35[b]	0.001*	31.4%	0.60[c]
Standing broad jump (m)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.001*	10.5%	0.70[c]
Sit-ups (reps)	-	-	-	-	-	-	0.000*	90.3%	0.60[c]	-	-	-	-	-	-	0.000*	57.6%	0.53[c]
10x5 meter run (sec.)	-	-	-	-	-	-	0.009*	59.7%	0.51[c]	-	-	-	-	-	-	-	-	-
20m shuttle run (laps)	-	-	-	-	-	-	-	-	-	0.003*	63.4%	0.50[c]	0.016*	82.6%	0.7[c]	0.033*	36.6%	0.55[c]

*$P < 0.05$; Con= control group; Exp= Experimental group; ES=Effect size; small effect ≥0.1[a], medium effect ≥0.2[b], large effect ≥ 0.5[c]; Per=Percentage

4. Discussion

This study investigated the effects of an enhanced quality PE programme on physical and motor fitness levels of South African Grade 7 learners. The results generally showed significant beneficial effects in three of the experimental groups for all the fitness measurements except for bent arm hang and flamingo balance, whereas none of the control groups showed statistically significant differences.

Regarding the fitness components, practically significant differences were found between pre- and post-test scores in one to three of the experimental groups in the score obtained for the sit and reach, standing broad jump, sit-ups, 20m shuttle run, plate tapping, and 10x5m shuttle run parameters after the intervention. Non-significant differences were found in the control groups. The improvement in the sit and reach test, which reflects children's flexibility, is consistent with the findings of other studies on children of similar age groups (Kemp & Pienaar, 2009; Mavridis *et al.,* 2004; Pienaar *et al.*, 2013) but inconsistent with the findings of Eather *et al*. (2013) who investigated a multi-component school-based intervention programme (incorporated with curriculum components, nutrition and family involvement) on health-related fitness and PA in 10 year-old Australian primary school children. The results indicated that the programme did not yield any treatment effects for flexibility although the total fitness scores and PA levels significantly improved after the intervention. However, studies including strategies designed specifically to improve flexibility in children are sparse.

With regard to cardiorespiratory endurance, measured by the 20m shuttle run test, the adjusted mean values revealed that aerobic fitness significantly increased in three of the four experimental groups (groups 2, 3 and 4) due to the effect of the intervention programme, and these improvements showed large practical significance effects. This finding is widely supported by the literature, with the majority of school-based PE interventions reporting significant treatment effects regarding improvements in aerobic endurance (Zhou *et al*., 2014; Kriemler *et al*., 2010; Kemp & Pienaar, 2009). A recent 10-month primary school-based study conducted in Switzerland by Kriemler *et al*. (2010) reported a significant increase in aerobic fitness among 498 children aged 11 years corresponding to a difference in running time of 20 seconds and over a distance of 60 meters equivalent to an average increase of 5% from the baseline training session. These findings are also comparable to those reported in a similar study by Zhou *et al*. (2014). In our study, the non-significant improvement in the cardiorespiratory endurance were found in experimental group 4 could be explained in the light of the fact that the learners already had a high level of cardiorespiratory endurance in the baseline assessment.

Consequently, the intervention programme merely sustained the level of cardiorespiratory fitness in this group.

Our results which showed improved scores in the standing broad jump test (experimental group 4) and sit-up tests (experimental groups 1 and 4), which are measures of explosive strength and abdominal muscular endurance, are consistent with the findings of some intervention studies (Pienaar *et al*., 2013; Mavridis *et al.,* 2004), although higher than those of a study by Eather *et al*. (2013) which investigated a multi-component school-based intervention programme on health-related fitness and PA of Australian primary schoolchildren, and found low treatment effects in muscular fitness tests.

The adjusted means of the dependent variables in our study further revealed that the plate tapping and shuttle run tests, which assess speed of limb movement, body movement and agility, significantly improved in one of the experimental groups (group1). These findings corroborate the reports of a similar study where a fitness training programme yielded improvements in the plate tapping and shuttle run tests (Pan *et al*., 2014). Likewise, García-Hermoso *et al*. (2014) investigated a six-month physical exercise intervention programme on fitness levels of 8-11 year-old Spanish boys with and without diet by using the EUROFIT test battery. The authors observed significant changes in various PF parameters, including limb speed and agility as determined by the plate tapping and 10x5 m shuttle run tests, respectively.

In summary, even though the same intervention programme was presented to all four experimental groups, this study found different degrees of improvements among the experimental groups suggesting that different teaching styles used by the four PE teachers might have influenced the outcomes of the intervention. It is therefore recommended that the effects of different teaching styles should be investigated in future PE intervention research. However, as the results of this study showed improvements in several fitness components among the experimental groups, in contrast to the control groups, it could be conclude that these positive changes may be attributed to the enhanced quality PE intervention programme. It is, therefore, strongly recommended that even though the South African curriculum prescribes the presentation of PE only once a week in the school time table, the PE programme should be presented by well-trained teachers, and should also include the other components of enhanced quality PE as described in this study, namely homework activities, a reward system, improvised apparatus, and monitoring of the intensity of activities.

4. Limitations and Conclusion

The results of this study should be interpreted in the light of some limitations. Firstly, the increased physical and motor fitness levels which were found in this study may be attributable to a temporary effect which may not be sustainable. Thus further interventions might be required to sustain the improvements noted. Secondly, the small sample size of this study confounds the generalization of our results and warrants the need for further research to be conducted with larger sample sizes in order to substantiate the present findings. However, the usefulness of our study lies in the fact that the enhanced quality PE intervention programme was effective in increasing children's physical and motor fitness levels, and thus provides a valuable framework for PE curriculum development and implementation targeted at promoting the PF levels of primary school learners.

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