Effects of 10-week active recess programme in a school setting on school aptitudes, creativity and cognitive flexibility in children 8-12 years

Abstract

Background: The recommendations for physical activity (PA) are more than 30 minutes per day. However, few children reach that goal every day. Active recess programmes that promote the performance of PA is an effective way of achieving that goal. In addition, the cognitive benefits linked to PA are numerous. The increase of school skills as well as the executive functions are some of those benefits. **Methods:** A total of 114 children (57 females and 57 males) participated in this study. The students were randomly assigned to two groups (experimental group and control group). Experimental group (EG) (n=58) participated in an active recess programme for 10 weeks (three times a week), however control group (CG) (n=56) did not performance any kind of physical exercise. School skills were assessed by TEA test, creativity by PIC-N test and cognitive flexibility by Trail Making test in both conditions (pre-test/post-test). **Results:** In relation to school aptitudes, as for group x time interaction (within-group), the experimental group (EG) experienced significant improvements in all school aptitude ($p<0.001$), whereas the control group (CG) did not experience significant changes. Regarding creativity, the EG experienced significant improvements in creativity variables (fluency, flexibility, narrative originality, elaboration, shadows and colour and special details variables) except graphic originality, title and details, whereas the CG significantly worsened ($p<0.05$). Finally, on cognitive flexibility only EG showed significant improvement reflected in part B of the Trail Making test. **Conclusions:** Our findings show active recess programmes are pedagogical tools of enjoyment and improvement for school aptitudes, creativity and cognitive flexibility of school-age children. Therefore, programs that promote movement in school setting are necessary.

Keywords: Active recess, Creativity, Physical activity, School aptitude, Cognitive flexibility

Introduction

The importance of physical activity (PA) for health is well known and research has noted both physical and psychological benefits when children participate in physical activities (Ahn & Fedewa, 2011). However, 82% of the child population in Europe does not comply with the recommendations of the World Health Organization (WHO) regarding PA (Konstabel et al. 2014). The PA recommendations for elementary school are more than 30 minutes of MVPA per day through physical education (PE) and recess; especially recommended is at least 20 minutes of recess per day (Carlson et al. 2013). In Spain, PE classes in elementary schools are structured in two 45-minute sessions per week with different forms of PA. Therefore, children cannot comply with international PA recommendations to maintain and improve health in PE; consequently, recess could help children to reach PA goals. In this regard, Physical education and recess are great opportunities to complete the daily PA goal without showing any evidence of compromising academic performance (Strong et al., 2005). However, most of the PA intervention studies to improve cognitive processes in school children attempted to increase participant PA with physically active classroom lessons or additional school PA (Donnelly et al. 2016); however, classroom PA breaks such as active recess have been less studied.

On the other hand, there is a great connection between cognition (Heinonen et al. 2008) and PA (Ortega et al., 2011). The study of increase of time spent performing PA on cognition, especially in preadolescents, has generated great interest due, among other reasons, to the positive impact that the proper functioning cognitive may have for your personal and social development (Santana et al. 2017). Children with better physical capacity exhibit greater cortical activation and corresponding cognitive performance than children who do not do physical activity (Tomporowski et al. 2008), and there is a close association of motor development and cognitive development in the cerebellum and prefrontal cortex (Diamond 2000). Moreover, there is a causal relationship between physical fitness and the vitality of the brain (Tomporowski et al. 2008). The PA and cognition link is supported by the running of neural regions during performance of motor tasks, which is associated with cognitive functions (Budde, Voelcker-Rehage, Pietraßyk-Kendziorra, Ribeiro, & Tidow, 2008; Diamond, 2000; McPherson, Mackay, Kunkel and Duncan 2018). In addition, perform PA increase cerebral blood flow (Querido and Sheel 2007). This is supported by neuroimaging techniques, which show a close activation of the prefrontal cortex and the cerebellum, which are both related to motor and cognitive skills (Stoodley, Valera, & Schmahmann, 2012). Ikuta et al. (2018) assessed the hippocampal-orbitofrontal functional connectivity from magnetic resonance imaging showing that association was produced only when vigorous-intensity physical activity was carried out. A review showed that physical fitness, single bouts of PA, and PA interventions benefit children's cognitive functioning (Donnelly et al. 2016). In addition, specifically, cardio respiratory fitness and motor skills play an important role in cognitive development during childhood and young adulthood (Haapala et al., 2013). Therefore, a better development and neural organisation is caused in children with higher physical fitness during early periods of the lifespan (Latorre Román, García Pinillos, Pantoja Vallejo, & Berrios Aguayo, 2017; Hillman, Buck, Themanson, Pontifex, & Castelli, 2009).

In particular, PA shows an acute effect on executive functions like attention, working memory, inhibition, cognitive flexibility (Pirrie & Lodewyk, 2012; Pontifex, Hillman, Fernhall, Thompson, & Valentini, 2009). Hillman, Buck, Themanson, Pontifex, & Castelli (2009) showed that single bouts of moderately-intense aerobic exercise may improve the cognitive control of attention in preadolescent children**.** Pontifex et al. (2013)

showed greater performance in the areas of reading and arithmetic following a single 20-minute bout of exercise in children. Likewise, several studies displayed that high intensity training (HIT) improve cognitive functions (Cooper et al., 2016; Kao et al. 2018; Moreau, Kirk, and Waldie 2017).

Therefore, there is emerging evidence that HIT (particularly game-based activity) is beneficial for cognitive function in young people; however, more studies are needed to clarify this relationship, specifically relating to the effect on different age ranges (e.g., children vs adolescents) or on different cognitive process. In addition, the time course of the changes in cognitive function after HIT is yet to be reported, so it is unknown how long the beneficial effects of exercise persist (Cooper, Dring, and Nevill 2016).

According to the information reported above, in preadolescent children short aerobic exercise bouts of moderate-vigorous intensity may be used to restore cognitive resources in school, which is positive for learning processes (Berrios Aguayo, Latorre Román, & Pantoja Vallejo, 2017; Ludyga, Gerber, Brand, Holsboer-Trachsler and Pühse 2016). Creativity is one of the cognitive abilities that can be increased by performing PA (Latorre Román, Pantoja Vallejo, and Berrios Aguayo 2018) and also the development of it can be a tool for improving the learning process (Birgili 2015; Gordon and O'Toole 2015). On the other hand, cognitive flexibility is another cognitive capacity that allows improving learning through the adaptation of our brain to new situations. Performing PA cognitive flexibility can be improved in schoolchildren. For example, Ludyga et al. (2019) showed link between high competences in locomotor skills and object control skills with high performance on specific executive function like as cognitive flexibility in preadolescent children.

Taking into account the literature review, the research hypothesis states that active recess programmes during several weeks increases the level of cognitive development and school skills. Therefore, the purpose of this study was to examine the effects of a 10-week active recess programme based on HIT on school aptitudes, creativity and cognitive flexibility in children 8-12 years old.

Method

Participants

Participants randomly assigned were 140 students. One hundred and fourteen students, including 57 females and 57 males, meet the selection criterial (voluntarily participation, signed informed consent, etc.) and finished the intervention completely. Figure 1 shows the flowchart of this study. Children were recruited from three local elementary schools in Jaen (Spain). Children were randomly assigned by computer forming the experimental group (EG, n=58, age=9.76±1.09 years old, BMI=19.36 ±3.80 kg/m^2, 50% girls) and the control group (CG, n=56, age=9.77±1.11 years old, BMI=19.60 ±3.83 kg/$m^{2,}$ 44.6% girls) in each school. The students with intellectual or physical disabilities were not involved in this study (information obtained from the psychological school team). Parental consent was obtained for the participants. The study was conducted in adherence with the standards of the Declaration of Helsinki (2013), and the informed consent and the study were approved by the Bioethics Committee from the University of Jaen (Jaen, Spain).

Include Figure 1 here

Materials and testing

Parents completed a sociodemographic questionnaire with information about marital status, parent antopometric data and parents and children sports practice.

Anthropometric data of children was assessed by previously trained PE teachers while the cognitive tests were assessed by a previously trained educational psychologist.

Height (cm) was measured with a stadiometer (Seca 222, Hamburg, Germany) and weight with a weighing scale (Seca 899, Hamburg, Germany). Body mass index (BMI) was calculated by dividing weight (in kilograms) by height^2 (in metres).

School skills were assessed by Test de aptitudes escolares (TEA) (Thurstone & Thurstone, 2012). It evaluates intelligence from the classic approach that understands this as the aptitude of the subject to learn. It is divided into 3 levels, which reconcile the evaluation of performance in school tasks. Each level explores 3 fundamental school skills: Verbal, Numerical and Reasoning. The verbal skill is assessed by pictures (verbal identification of picture), different words (verbal reasoning) and vocabulary (verbal understanding); adding these parts comprises the total verbal aptitude (maximum and minimum values = 0-50). On the other hand, the addition of reasoning (maximum and minimum values = 0-27) and numerical skills (maximum and minimum values = 0-55) is the total of non-verbal aptitudes (maximum and minimum values = 0-42). Finally, adding verbal and no verbal skills is the total score measuring real school aptitude (maximum and minimum values = 0-132). Each activity, to evaluate any aptitude, has a maximum time to be performed. When the time is up, children had to stop writing. Regarding the internal consistency reliability, this test showed a Cronbach's alpha = 0.86 for verbal component; Cronbach's alpha = 0.82 for numeric; Cronbach's alpha = 0.93 for reasoning and Cronbach's alpha = 0.92 for total score (Alva 2014).

Creativity was measured with the Prueba de imaginación creativa - niños (PIC-N) (González and Mairal 2004), which was partly inspired by the classic studies of Guilford and Torrance. The PIC-N, which has been shown to have good psychometric properties, was specifically designed for the Spanish population and is widely used for the assessment of creativity (Ferrándiz et al. 2017; Soto et al. 2015). It evaluates creativity by examining how subjects use their imagination in four different tasks; the first three tasks or games focus on narrative creativity (maximum and minimum values = 0-99) whilst the fourth task gauges graphical creativity (maximum and minimum values = 0-44). In game 1, the instructions were: “Look at the picture and imagine everything that could be happening. Don't tell a story, but write all the ideas that come to your mind (each one on a different line). In this game, there are no right or wrong answers, so let your imagination run and try to write as many ideas as you can.” In game 2, the instructions were: “Write a list of everything that you could do with a plastic pipe. Think of interesting and original things, however fantastic they may be. You can use the number and length of pipes you wish.” In game 3, the instructions were: “Imagine what would happen if suddenly every squirrel became a dinosaur. Don't tell a story, but write a list of the things that could happen”. Finally, in game 4, the instructions were: “On this page you will see some incomplete drawings. Try to complete them with such originality that no one else would draw the same thing. When you have finished, write an interesting title for each drawing.” Indicators of fluency, flexibility, originality, elaboration, shadows and colour, title and special details can be recorded. The internal consistency reliability of total score of PIC-N test was Cronbach’s alpha = 0.83 (Artola, Ancillo, Barraca & Mosteiro, 2010). These authors determine also several data of PIC-N validity for total creativity shows next statistical significances: 0.30** with factor G, 0.34** with RAVEN, 0.23** with EDAC (High Ability Test).

The executive functions focused on speed of processing and cognitive flexibility were assessed by Trail Making Test (TMT) A and B. This test measures the character trait that attends to 4 factors: targeting, alternation, coding and surveillance (Reitan, 1958). The TMT consists of two parts. TMT-A requires drawing lines sequentially connecting 25 encircled numbers distributed on a sheet of paper. Task requirements are similar for TMT-B except the person must alternate between numbers and letters (e.g., 1, A, 2, B, etc.) (Tombaugh 2004). TMT-A measures motor skills, viso-spatial visual search and sustained attention; TMT-B measures flexibility mental and divided attention and students have to link numbers with letters in an ascending way. The test score was the running time, so that a longer time indicates a poorer performance. Reliability test-retest were for the TMT-A, intraclass correlation coefficient, ICC=0.983, 95% confidence interval = 0.968-0.991, and for the TMT-B, ICC=0.950, 95% confidence interval= 0.829-0.948. Leòn-Carriòn (1989) did not observe significant differences between the American infant population recollected by Reitan (1971) and the Spanish infant population.

Procedure

After obtaining the appropriate permits from the schools and informed consent from parents, we carried out the tests and administered the questionnaires. The evaluations were carried out over two separate sessions by a team of trained researchers in classroom. Students were assessed on the different questionnaires twice, before application of active recess programme, and immediately after its completion. The questionnaires were completed individually and in the presence of researchers, respecting the confidentiality of the data and clarifying the doubts arising.

Intervention

Participants in the EG performed three times a week (Monday, Wednesday, and Friday) an active recess programme for 10 weeks in school settings. The sessions were conducted by PE teachers-in-training and graduate students of the principal investigator who previously trained them to collect data. All sessions included a high-intensity intermittent training (HIIT) which generally refers to repeated short to long bouts of high-intensity exercise – performed at close to 100% maximal oxygen uptake (VO_2max) – interspersed with recovery periods. In a school setting, we employed a HIIT such as small-side games (SSG) (Bujalance-Moreno, García-Pinillos, and Latorre-Román 2017) (e.g.; football, basketball). These games are used to improve skill and physical fitness in team sport athletes since they require greater cognitive effort and improve aerobic adaptations. It has specific conditions regarding the size of the field of play, number of players, the time of the session, methodology and tactical action. In this study, the size of the pitch, the number of players and the methodology were manipulated in an attempt to alter the intensity and complexity of the SSGs (Table 1) according to previous studies (Bujalance-Moreno et al., 2017). During the SSGs, the participants were encouraged to reach an effort level between 6 and 10 points on the Borg scale (Borg 1982) which rates items from 0-10 (low intensity to high intensity).

During the 10-week period, participants in the CG continued with their daily activities that did not include any kind of physical exercise similar to the study. Before and after the experimental protocol, body mass, body height, school aptitude, cognitive flexibility and creativity were assessment.

Include Table 1 here

Statistical analysis

Data were analysed using SPSS, v.19.0 for Windows (SPSS Inc, Chicago, USA) and the significance level was set at α=95%. The data are shown as descriptive statistics including mean, standard deviation (SD) and percentages. Tests of normal distribution and homogeneity (Kolmogorov-Smirnov and Levene's respectively) were conducted on all data before analysis. A 2x2 analysis of variance (ANOVA) with repeated measures (group x measurement) was conducted for the dependent variables (school aptitude, creativity and cognitive flexibility). Additionally, effect sizes for group differences were expressed as Cohen's *d* (Cohen 1988); effect sizes are reported as: trivial (<0.2), small (0.2-0.49), medium (0.5-0.79), and large (≥0.8) (Cohen, 1988).

Results

The data collected in the sociodemographic questionnaire showed how the highest percentage of parents completed secondary and university studies (38.6 vs. 34.2 respectively) and that 91.2% of the parents had a medium socioeconomic level. In addition, 32.5 % of the parents confessed to practice sport. Children presented an average BMI value of (añadir valor medio de IMC). In addition, no significant between-group differences ($p \geq 0.05$) in age, anthropometric characteristics and sex distribution were found at baseline (before training intervention).

The results obtained regarding school aptitudes are shown in Table 2. The 2 x 2 ANOVA revealed significant effects for the time x group (groups comparison: CG vs. EG); both groups showed similar values at pre-test ($p \geq 0.05$) except on numerical aptitude, whilst significant interactions were found at post-test on all variables; EG had better scores. As for group x time interaction (within-group), the EG experienced significant improvements in verbal aptitude ($p<0.001$), numerical aptitude ($p<0.001$), reason aptitude ($p<0.001$), and no verbal aptitude ($p<0.001$) whereas the CG did not experience significant changes in any variable.

Include table 2 here.

The results obtained regarding creativity are shown in Table 3. The 2 x 2 ANOVA revealed significant effects for the time x group (groups comparison: CG vs. EG); both groups showed similar values at pre-test ($p \geq 0.05$) whilst significant interactions were found at post-test; EG showed better scores on all variables except graphic details, in which no significant differences were found. As for group x time interaction (within-group), the EG experienced significant improvements on all creativity variables except graphic originality, graphic title and graphic details; the CG significantly worsened

($p<0.05$) on graphic originality, graphic shadow and colour, graphic title and total creativity.

Include Table 3 here.

Figures 2 and 3 showed results of TMT before (pre-test) and after (post-test) a 10-week active recess both in EG and CG. In TMT-A there were significant differences in pre-test and post-test between EG and CG; EG displayed better performance. As for group x time interaction (within-group), both EG (pre-test=32.81±9.80, post-test=29.40±8.89, Cohen's d=0.367) and CG (pre-test=36.80±10.58, post-test=34.79±10.71, Cohen's d=0.193) experienced significant improvements. In TMT-B, no significant difference was found at baseline, however, in post-test, EG showed better performance. As for group x time interaction, only EG experienced significant improvement (pre-test=80.28±31.78, post-test=61.47±23.48, Cohen's d=0.679).

Include Figure 2 and 3 here

Discussion and conclusions

The purpose of this study was to examine the effects of a 10-week active recess programme based on the HIT on school aptitudes, creativity and cognitive flexibility in children 8-12 years old. The main finding indicated that active recess improves school aptitude, creativity and cognitive flexibility in schoolchildren. Similarly, van der Niet et al. (2016) showed that a 22-week physical activity program for 30 min during lunch recess, twice a week improves the executive functions such as inhibition, working memory, cognitive flexibility and planning.

Active recess dedicated to SSG requires coordination movements and a development of strategies while children are playing. Aadland et al. (2019) showed in 971 fifth grade children as cognitively engaging and coordinative demanding activities / games during school day improve executive functions such as the cognitive flexibility of students. An explanation of those results reported by Wassenberg et al. (2005) is that development of specific cognitive skills and motor performance occurs in parallel, thus, specific brain structures and systems, such as the basal ganglia or frontal cortex and dopamine transmission, are involved in both cognitive and motor performance. Therefore, the results of this study provide some support for the argument that an active recess can activate the area of the brain needed for better cognitive development. Moreover, physical education and recess are great opportunities to complete the daily PA goal without showing any evidence of compromising academic performance (Strong et al. 2005).

On the other hand, previous studies have shown that PA programmes in the classroom and after-school fitness programmes improve academic performance, executive function and other cognitive skills in children (Mullender-Wijnsma et al., 2015). Mullender-Wijnsma et al. (2015) employed actives classes; both studies showed a higher performance on mathematic but only Mullender-Wijnsma et al. (2015) on the reading task. Fisher et al. (2011) performed an intervention study for 10 weeks increasing the hours of PE (an increase of 2 hours per week) with children obtaining better scores on memory and attention with increased PE hours. These results agree with the findings of our study as they confirm the importance of PA programmes on school performance and cognitive skills.

However, other previous studies did not show significant effects of PA on cognitive processes. Kvalø et al. (2017) did not find significant differences in 10-11 years old children that performed physically active academic classes, physically active breaks, and physically active homework during 10 months on their executive functions. The authors concludes by requiring longer interventions. Ahamed et al. (2007) did not show enhancement in PA when children did an intervention programme increasing the hours of physical education. Moreover, de Greeff et al. (2016) did not find a positive result after an intervention programme consisting of 2 years of performing three active academic lessons per week of MVPA on executive function like inhibition, cognitive flexibility and working memory. Finally, Donnelly et al. (2016) reported that no studies that examined the use of PA breaks in the classroom showed positive results on academic achievement.

Several limitations associated with this study should be considered: (i) not carrying out subsequent monitoring of the improvements; (ii) intensity was not monitored during the training programme and PA; (iii) the failure to check the PA and fitness levels of the participating children, (iiii) the lack of a process assessment. Notwithstanding these limitations, to our knowledge, little is known about the effects of active recess on cognitive processes in children; so one of the strengths of our study is that it is represents a pioneering contribution to this area of research. More research is needed to make school authorities confident that encouraging school PA will improve learning rather than disrupt academic performance (Biddle and Asare 2011).

In conclusion, active recess based on HIT can be a proper tool to improve some cognitive skills such as school aptitudes, creativity and cognitive flexibility. According to Davis et al. (2007), given that children's brains continue to develop during the school years, the results of this study may even promote their definitive neural development potential and therefore, improve their long-term abilities and achievement. These findings carry significant implications for PA in schools. Schools should promote interventions that increase PA for children during recess, which would lead to improvements in health and cognitive development.

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Table 1. Participants´ sociodemographic data

	Factors		Value
Parents	Educational level (%)	Elementary school	27.2
		High school	34.2
		University	38.6
	Socioeconomic level (%)	Low	3.4
		Medium	91.2
		High	5.4
	Sport practice (%)	Yes	32.5
		No	67,5
Children	BMI (kg/m^2) Mean (SD)		añadir mean (SD)
	Sport practice (%)	Yes	59,3
		No	40.7

Table 2. Detailed description of the 10-week SSGs programme, including exercises, field area, area per player, methodology, duration of recovery and SSGs time

Weeks (1-10)	SSG players	Goalkeepers	Field area (m x m)	Area per player* (m^2)	Methodology (sets x min)	Duration of recovery interbouts (min)	Total SSG duration (min)	Tactical actions
1-2	6 vs. 6	Yes	20x15	25	5x3	2	23	Possession+ Offensive+Defensive+Global game.
3-4	5 vs. 5	No	20x10	20	4x4	2	22	
5-6	4 vs. 4	No	20x8	20	4x4	2	22	
7-8	4 vs. 4	No	20x8	20	4x4	2	22	
9-10	3 vs. 3	Yes	15x10	25	3x5	2	23	

Note: *Area per player (m^2) = Total pitch area divided by total number of players. Small-sided games (SSGs).

Table 3. School aptitudes parameters before (pre-test) and after (post-test) a 10-week active recesses program

Variables	Groups	Pre-test Mean (SD)	Post-test Mean (SD)	P-value (group x time)	Cohen´s d
Verbal aptitude	CG	29.59 (6.57)	30.36 (5.60)	0.173	-0.127
	EG	29.50 (5.92)	34.02 (5.80)	<0.001	-0.778
p-value (time x group)		0.939	0.001		
Numerical aptitude	CG	17.70 (7.51)	17.71 (7.64)	0.975	-0.001
	EG	20.84 (7.81)	24.47 (7.26)	<0.001	-0.485
p-value (time x group)		0.031	<0.001		
Reason aptitude	CG	18.75 (4.11)	19.27 (4.41)	0.188	-0.123
	EG	19.38 (4.46)	21.34 (3.59)	<0.001	-0.488
p-value (time x group)		0.436	0.007		
No verbal aptitude	CG	36.45 (10.13)	36.82 (10.60)	0.649	-0.036
	EG	40.31 (10.24)	46.16 (9.30)	<0.001	-0.603
p-value (time x group)		0.047	<0.001		
Total school aptitude	CG	65.86 (14.86)	67.45 (14.26)	0.123	-0.110
	EG	69.81 (14.33)	80.19 (13.06)	<0.001	0.763
p-value (time x group)		0.151	<0.001		

Note: Standard deviation (SD); Control group (CG); Experimental group (EG)

Table 4. Creativity parameters before (pre-test) and after (post-test) a 10-week active recesses program

Variables	Groups	Pre-test Mean (SD)	Post-test Mean (SD)	P-value (group x time)	Cohen's d
Narrative fluency	CG	9.70 (4.00)	9.89 (3.59)	0.636	-0.050
	EG	9.67 (3.56)	12.29 (4.77)	<0.001	-0.628
p-value (time x group)		0.973	0.003		
Narrative flexibility	CG	7.11 (2.28)	6.89 (1.83)	0.537	0.107
	EG	7.10 (2.29)	9.40 (3.47)	<0.001	-0.789
p-value (time x group)		0.993	<0.001		
Narrative originality	CG	2.86 (2.35)	2.32 (2.15)	0.169	0.241
	EG	3.09 (2.39)	5.47 (2.68)	<0.001	-0.945
p-value (time x group)		0.608	<0.001		
Total narrative creativity	CG	19.61 (6.59)	19.11 (6.12)	0.578	0.079
	EG	19.88 (6.83)	27.29 (10.23)	<0.001	-0.859
p-value (time x group)		0.829	<0.001		
Graphic Originality	CG	9.70 (2.38)	8.86 (2.43)	0.015	0.352
	EG	9.60 (2.68)	10.10 (2.28)	0.137	-0.202
p-value (time x group)		0.846	0.006		
Graphic design	CG	2.09 (1.83)	1.75 (1.43)	0.123	0.208
	EG	1.74 (1.54)	2.67 (1.23)	<0.001	-0.673
p-value (time x group)		0.274	<0.001		
Graphic shadow and colour	CG	0.48 (0.83)	0.14 (0.40)	0.015	0.526
	EG	0.28 (0.61)	0.74 (1.11)	0.001	-0.518
p-value (time x group)		0.134	<0.001		
Graphic title	CG	1.52 (1.61)	0.71 (1.07)	0.002	0.595
	EG	1.41 (1.77)	1.99 (1.68)	0.051	-0.339
p-value (time x group)		0.745	<0.001		
Graphic details	CG	0.73 (0.94)	0.50 (1.04)	0.071	0.234
	EG	0.64 (0.87)	0.86 (0.98)	0.076	-0.239
p-value (time x group)		0.581	0.059		
Total graphic creativity	CG	14.55 (5.19)	11.95 (4.72)	<0.001	0.528
	EG	13.67 (4.96)	16.22 (4.70)	<0.001	-0.595
p-value (time x group)		0.356	<0.001		
Total creativity	CG	34.16 (9.12)	30.82 (8.47)	0.003	0.382
	EG	33.57 (9.45)	43.69 (13.49)	<0.001	-0.876
p-value (time x group)		0.735	<0.001		

Note: Standard deviation (SD); Control group (CG); Experimental group (EG)

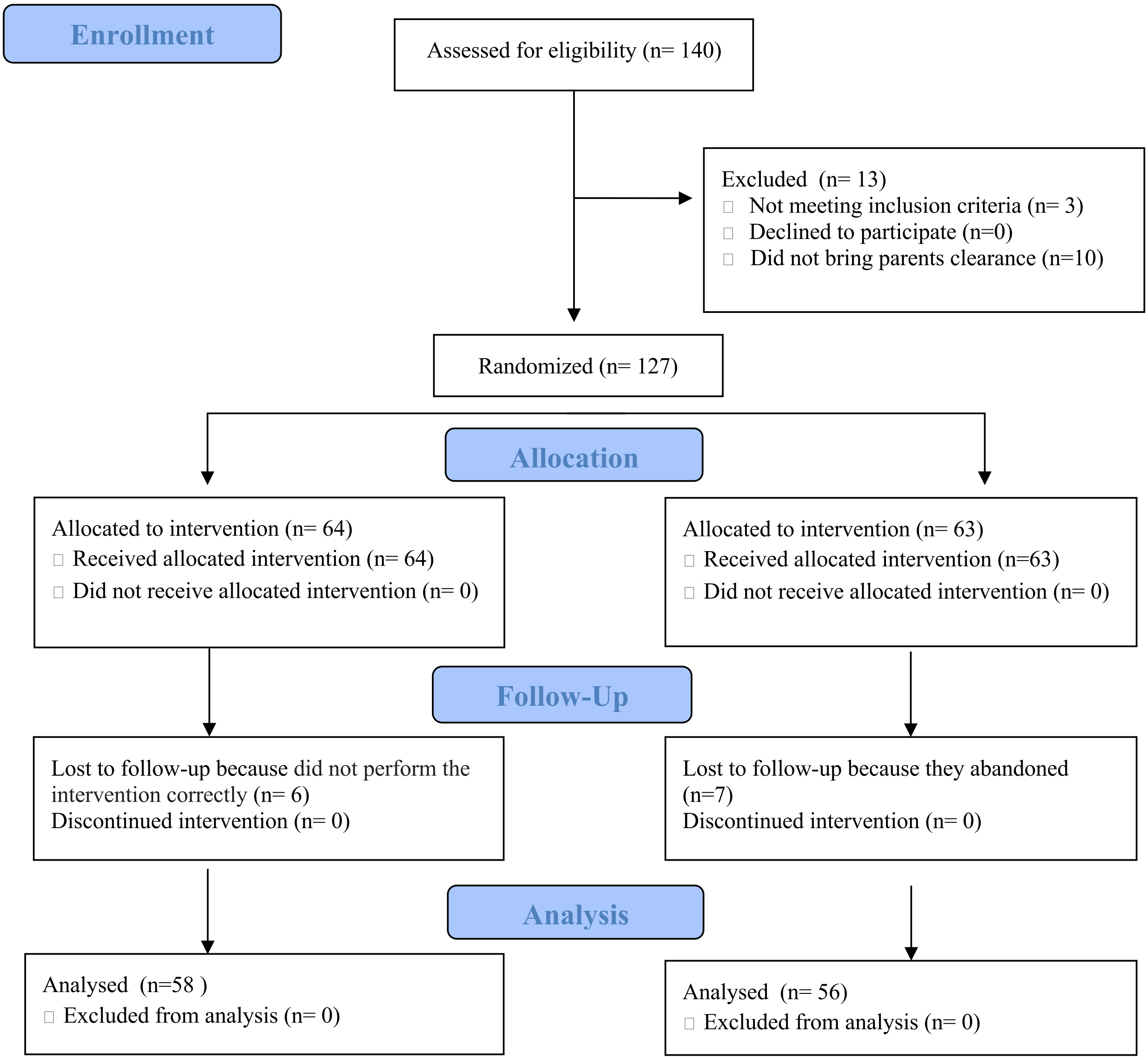

Figure 1. Flow Diagram (CONSORT 2010)

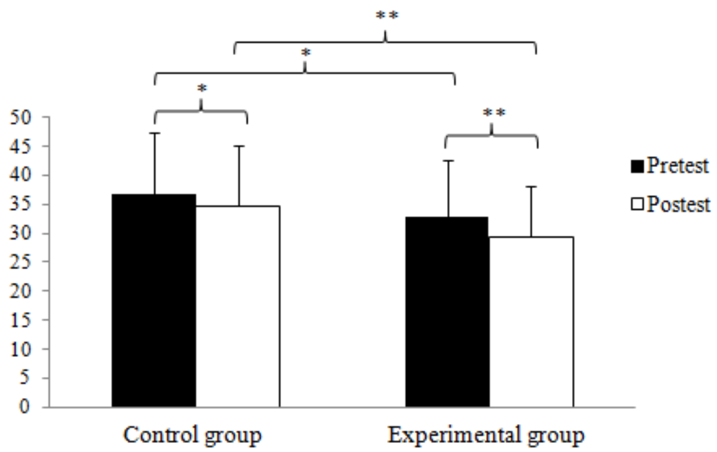

Figure 2. TMT-A before (pre-test) and after (post-test) a 10-week active recesses both in EG and CG.

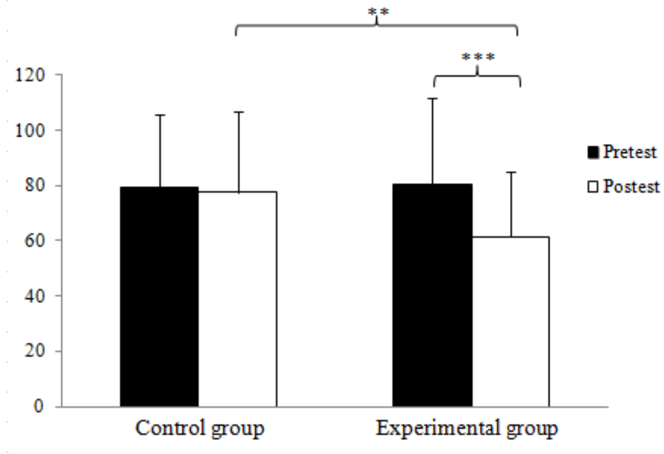

Figure 3. TMT-B before (pre-test) and after (post-test) a 10-week active recesses both in EG and CG.