ORIGINAL ARTICLE

IJPHY

EFFECTIVENESS OF FLOOR EXERCISES VERSES BALL EXERCISES ON SPINAL MOBILITY IN SPASTIC DIPLEGIC

[1]Sumitra Sakhawalkar
[2]Sayli Paldhikar
[3]Priya Chitre
[4]Snehal Ghodey

ABSTRACT

Background: The objective of this present study was to determine the Effectiveness of Floor Exercises versus Ball Exercises on spinal mobility in Spastic Diplegic.

Methods: Institutional ethical committee permission was taken before starting the study. A sample of 70 Diplegic CP children was screened, and 40 meeting the inclusion criteria were selected for study were then randomly divided into two groups one control other experimental i.e. 20 in each group by chit method. Both the groups were assessed with spinal goniometry using Tape measurements for Thoracolumbar spine and Modified Schober's Test (MMST)before and after the treatment. Control group were given Floor exercise on a mat, and Swiss ball was giving experimental group Ball exercises for ten repetitions with 10-second hold, treatment time was 40 min per session for 3days per week for six weeks. Same sustained stretching technique for both groups in bilateral lower extremities for ten repetitions with 30 sec hold was given for, TA, Iliopsoas, Hamstrings, Hip Adductor, Rectus femoris.

Result: Significant improvement was noted in the Intra-group comparison of both the groups from baseline to post six weeks of intervention p-value 0.001*** in both groups, and the Intergroup analysis using with tape measurements for Thoracolumbar spine (p-value) and MMST (p-value 0.133NS).

Conclusion: The present study concludes that there is a similar effect of both Floor Exercises versus Ball Exercises on spinal mobility in Spastic Diplegic.

Keywords: Ball exercises (using Swiss Ball), Cerebral palsy(CP), MMST (Modified Modified Schober's test), Spastic Diplegic (one type of CP), Floor exercises using a mat, spinal mobility.

Received 27th January 2017, revised 24th March 2017, accepted 30th March 2017

10.15621/ijphy/2017/v4i2/141951

www.ijphy.org

[2]Professor, HOD Neurophysiotherapy Department/ Maeers Physiotherapy College, Talegaon Dabhade Pune Maharashtra. India.
[3]Associate Professor, Neurophysiotherapy Department / Maeers Physiotherapy College, Talegaon Dabhade Pune Maharashtra. India.
[4]Principal, Maeers Physiotherapy College, Talegaon Dabhade Pune Maharashtra. India.

CORRESPONDING AUTHOR

[1]Sumitra Sakhawalkar

Assistant Professor, Neurophysiotherapy Department / Maeers Physiotherapy College, Talegaon Dabhade Pune Maharashtra. India.

INTRODUCTION

Cerebral palsy (CP) is a common developmental disability first described by William Little in the late 1840s[1].Sophie Levitt [1]et al 1977 defined CP as an "umbrella term covering a group of non-progressive, but often changing, motor impairment syndromes are secondary to lesions or anomalies of the immature brain arising in the early stages of its development" [1,2,3]. Prevalence of CP. is in the range of 2.5 to 3 per 1000 live births according to Indian pediatric society, while exact figures are unavailable in India [4,5].

The developmental delay in the normal sequence of motor development in CP child leads to abnormal patterns of movements which eventually lead to malalignment of the architecture of neutral spine leading to restricted spinal mobility. These malalignments become more evident in due course of time as spinal deformity [6,7]. The reason abnormal postures formed as a result of tight shorter spastic muscle groups whose antagonists are weak and cannot overcome the tight pull of the spastic muscles and so cannot correct the abnormal postures [8,9].

Voluntary movements are directly affected as poor trunk control interferes with the efficiency of the weakness of both postural muscles leading to reduced postural stabilization and orientation and abnormal movement patterns [7]. When a child makes a voluntary movement, he has to maintain his balance as he does so. If his postural stability and counterpoising are inadequate, the child may not be able to initiate or carry out the movement [1]. Should he manage to carry out an active movement on a background of unstable posture, the movement can be either imprecise, clumsy, in coordinated or weak [1,6]. Lack of isolated or discrete movements and fine motor coordination are also delayed with the spastic type of ambulatory CP patients leading to poor trunk dissociation pattern of the trunk with head and lower extremities [10,11].

Core muscle activation forms an integral part of stabilization of spine during weight bearing of the spine [12,13].

Efficient core allows for

- Maintenance of normal length-tension relationships of abdominals and back extensors along with hip musculature.
- Maintenance of normal force couples between abdominals back extensors pelvic girdle and hip musculature.
- Maintenance of optimal Arthro- kinematics of spine.
- Optimal efficiency in entire kinetic chain during movement of spine
- Acceleration, deceleration, dynamic stabilization of the spine.
- Provides proximal stability for movement of both upper and lower extremities [1,13,14].

A comprehensive strengthening or facilitation of these core muscles has been advocated as a way for complete spinal stability. Strong core muscles help stabilize the trunk and reduce the load of lumbar spine [14]. Training core muscles are, therefore, very essential for proper spine alignment during weight bearing. In Spastic Diplegics, Floor exercises for back extensors and abdominals were traditionally given with a stable and large base of support. They are effective in training the core muscles [15,16]. Later on, Swiss Balls (Bobath Ball) came into the picture as an effective aid for exercises in 1963. Quinton, in 1970, for the first time, used Stability Balls as play therapy for rehabilitation of children with neurological impairments [17,18].

The Aim of this study was to assess the Effectiveness of Floor Exercises versus Ball Exercises on spinal mobility in Spastic Diplegic. The objective of this study was to determine the:

1. The effectiveness of Floor Exercises on spinal mobility in Spastic Diplegic.
2. The effectiveness of Ball Exercises on spinal mobility in Spastic Diplegic.
3. To determine the Effectiveness of Floor Exercises versus Ball Exercises on spinal mobility in Spastic Diplegic.

Materials and Method

It was an experimental study, a Randomised Clinical Trial, a sample of 40 divided into 20 each group, i.e., control and experimental by Randomised purposive sampling technique. The study set up was Neuro Physiotherapy O.P.D in Rural hospital and CP school in Rural areas.

Inclusion criteria: 1. All ambulatory cerebral palsy patients (with or without Ambulatory aid / Orthosis) according to SAAROM (The spine alignment and range of motion measure scale (grade 0 to grade 2) [18] 2. Age 3 to 16yrs [2]. 3. Mini-mental state examination score ≥24 (cognition & perception deficit) [19].

Exclusion criteria: Cerebral palsy patients with MR and cognitive, perception dysfunction.

Materials Used: 1. Swiss Ball of (45 -65 cms), 2. Floor mat, 3. Measuring tape, 4. Marker, 5. Pen, 6. Paper.

METHODOLOGY

The sample 70 was screened, of which 40 meeting the inclusion criteria were selected. This sample of 40 Spastic diplegics was then randomly divided into two groups one control other experimental i.e. 20 in each group by chit method. Demographic data and basic Neurological examination were done. Both the groups were assessed with assessed with spinal goniometry using Tape measurements for Thoracolumbar spine and Modified Schober's Test (MMST), [18,19] before and after the treatment. Both the groups i.e. control and experimental were given the same sustained stretching technique for bilateral lower extremities for ten repetitions with 30 sec hold given for, TA, Iliopsoas, Hamstrings, Hip Adductors Rectus femoris. Control group were given stable surface, i.e., Floor exercise and experimental group were be given Ball Exercises Exercises were given in Supine Prone and Side-lying positions for ten repetitions with 10-second hold, treatment time was 45 min per session with 3days per week for six weeks [13,14,15].

Some of the exercises of the control group were: Curl-ups,

diagonal curl ups, bridging, prone on palms Quadripod position, bird dog position, prone hip extension [13,14].

Some of the ball exercises given were: Curl-ups and diagonal Curl-ups, rectus abdomius lengthening, bridging on Swiss Ball using the different base of support, Runners position, prone on palms prone hip Extension, Thoracolumbar Hyper Extension, Lengthening of Latissmuss Dorsi and Quadratus Lumborum [15].

Picture 1: Hyperextension of thoracolumbar spine on Swiss Ball

Picture 2: Rectus Abdominal lengthening

RESULTS

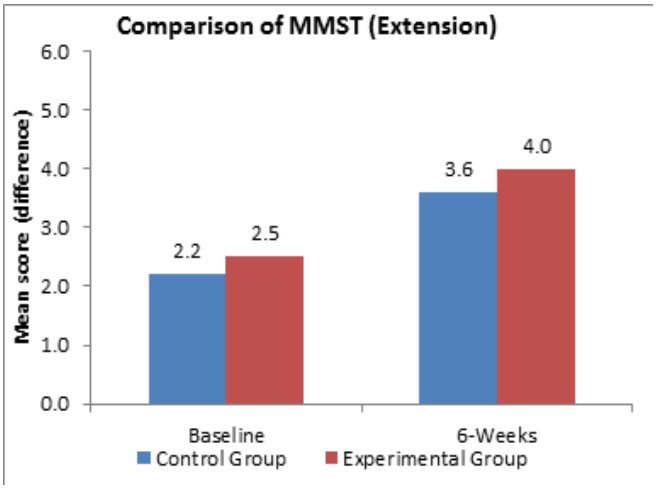
The data on qualitative characteristics (such as sex, age group, etc.) is presented as n (% of cases). The data on quantitative characteristics (such as MMST) is presented as a Mean ± Standard error of the mean (SEM) across two study groups. The statistical significance of the difference of qualitative characteristics across two study groups is tested using Chi-Square test. The assumption of normality of the given data in the present study was tested using the Shapiro Wilk's test. The statistical significance of the inter-group difference of the mean of quantitative characteristics is tested using unpaired 't' test, after confirming the underlying normality assumption of the difference of baseline and post-treatment parameters in each study group.

Table 1: The intra-group and inter-group comparison of Difference in Modified Modified Schober's Test (MMST) across two study groups.

MMST (cms) Difference Measurement		Control Group (n=20)	Experimental Group (n=20)	P-value [Inter-Group]
Flexion	Baseline	3.7 ± 0.35	3.2 ± 0.22	0.320^{NS}
	6-Weeks	5.4 ± 0.36	5.2 ± 0.23	0.631^{NS}
	% Change	57.9%	67.5%	0.279^{NS}
P-value [Intra-Group]	Baseline v 6-Weeks	0.001***	0.001***	--
Extension	Baseline	2.2 ± 0.17	2.5 ± 0.22	0.320^{NS}
	6-Weeks	3.6 ± 0.12	4.0 ± 0.18	0.059^{NS}
	% Change	78.1%	77.9%	0.989^{NS}
P-value [Intra-Group]	Baseline v 6-Weeks	0.001***	0.001***	--

Values are mean ± standard error of the mean. P-values for inter-group comparisons by unpaired t test. P-values for intra-group comparisons by paired t test. P-value<0.05 is considered to be statistically significant. * P-value<0.05, **P-value<0.01, ***P-value<0.001, NS: Statistically Non-Significant.

Graph 1: MMST (EXTENSION)



Graph 2: MMST (FLEXION)

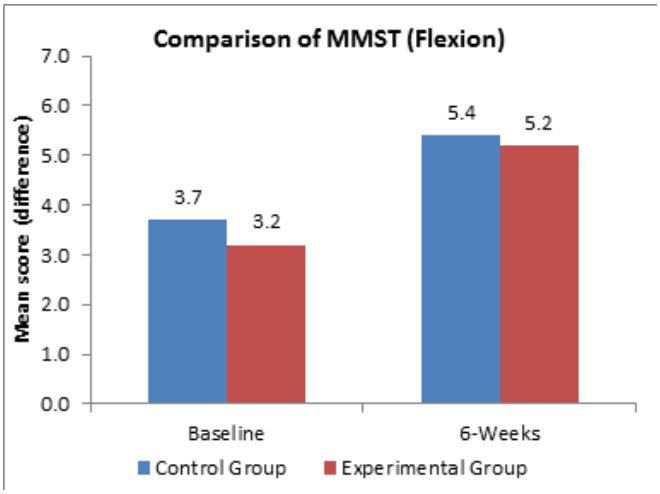


Table 2: The intra-group and inter-group comparison of Difference in Thoraco Lumber measurements across two study groups.

Thoraco Lumber Measurements –Difference (inches)		Control Group (n=20)	Experimental Group (n=20)	P-value [Inter-Group]
Flexion	Baseline	2.1 ± 0.19	1.9 ± 0.14	0.525^{NS}
	6-Weeks	3.4 ± 0.19	3.6 ± 0.17	0.388^{NS}
	% Change	74.6%	95.3%	0.133^{NS}
P-value [Intra-Group]	Baseline v 6-Weeks	0.001***	0.001***	--
Extension	Baseline	1.7 ± 0.16	1.4 ± 0.16	0.166^{NS}
	6-Weeks	2.9 ± 0.18	2.5 ± 0.21	0.161^{NS}
	% Change	85.8%	99.4%	0.467^{NS}
P-value [Intra-Group]	Baseline v 6-Weeks	0.001***	0.001***	--

The mean 6-weeks post-treatment Flexion and Extension Thoraco Lumber difference measurements are significantly higher compared to the baseline Flexion and Extension Thoraco Lumber difference measurements in Control and Experimental groups (P-value<0.001 for all).

DISCUSSION

Based on the Statistical analysis mentioned in the Results above, our study found that there is a similar effect of both Floor and Ball exercises on spinal mobility in Spastic Diplegic. Significant improvement was noted in the intra-group comparison of both the groups from baseline to post six-week Intervention as noted in the spinal mobility of Thoracolumbar spine using tape measurements and MMST.

This improvement in the outcome mentioned above measures can be attributed to the strengthening of abdominals, trunk extensors and lateral flexors, Hip and Pelvic Musculature given by Floor exercises on the mat in control group and Ball exercises in the experimental group using Swiss Ball. Exercises like Curl Ups and Diagonal Curl-ups gave both on Floor and Ball targeted to facilitate trunk flexors [14,15]. Curl-ups done on Ball provides spinal stabilization by fixing upper or lower trunk during exercise and allowing gravity to distract the spine by passive lengthening of the spinal attachments from the point of stability [15]. Garry T. Allison [20] et al. in 2008 explored. The global group of core muscles which consists of the large, superficial muscles like rectus abdominals, internal and external oblique abdominal, transversus abdominis, erector spine, lateral portion quadratus lumborum that transfer force between the thoracic cage and pelvis and act to increase intraabdominal pressure as the trunk becomes a more solid cylinder by the intra-abdominal pressure mechanism, there is a reduction in spinal axial compression and shear loads. The attachments of the transversus abdominis and internal oblique into the thoracolumbar fascia may enhance spinal and pelvic stabilization, because when these muscles contract they tense the thoracolumbar fascia [20].

Co–activation of the paraspinal muscles with rectus abdominis, external and internal oblique, and latissimus dorsi musculature is known to enhance trunk stability. The Floor and Ball curl ups exercise given also served to increase the mobility of trunk flexion by concentric work, allowing the spinal extensors to be activated in a stretched position [14,15]. During Curl up position, the hips are in flexed position with pelvis stabilized, thus reducing anterior pelvic tilt and decreasing lumbar hyperextension and correcting hyperlordosis [21]. Exercises like diagonal curl ups along with dissociation pattern of the trunk on the pelvis and lower extremity are known to cause the activation and lengthening of trunk extensors and lateral flexors (unilaterally) [22]. Mariana Felipe Silva et al. 2012 [23] In their study found that the obliques showed greater activation during the concentric phase of the traditional curl up and roll-up exercise with the Ball. During curl up the position itself of the exercise causes greater resistance to the upper limbs and upper trunk, thus, the oblique act to prevent excessive elevation of the thoracic rib cage. Also, the positioning of the pelvis and the amplitude and direction of movement requires trunk stabilization during the exercise, and the external oblique muscle contributes to this activity [23], this might have been one of the contributing factors for the functional improvement seen in Thoracolumbar measurements.

Prone development which activates head and back extension is frequently poor in a cerebral palsy child. According to the Bobaths [1], this position of the child first forms a reflex inhibiting posture for flexor tone in lower limb muscles and allows the pelvis to be stabilized[15]. During the prone exercises, like prone on elbows and palms, exercises performed on Ball as well as on Floors, improves the stabilization of hip and shoulder. Elongation of abdominal, mainly rectus abdominals, oblique's, transverses abdominals, iliopsoas, latissimus dorsi, facilitates the spinal extension. Isometric actions of rectus abdominis and oblique, along with concentric actions of the spinal extensors such as erector spinae, quadratus lumborum with co-activation of hip extensors, therefore, outsets the gravitational torque to extend the trunk and maintain the pelvis in neutral [14,15].

This finding was supported by a study done by Norwood JT, Anderson GS et all in 2007 [24] in their research described the Electromyographic activity of the trunk stabilizers during stable and unstable bench press. Surface electromyography (EMG) measured from 6 muscles (latissimus dorsi, rectus abdominis, internal obliques, erector spinae, and soleus) showed significant increases in EMG with increasing instability of unstable surface.They concluded that with the position that performing the bench press in a progressively unstable environment may be more effective in activating the core muscles, while the upper- and lower-body stabilizers can be activated differentially depending on the mode of unstable surface used [24]. This was noted in our in improving postural stability and orientation required by the child for spinal movements during weight bearing.

Soumya Ghosh, Soma Datta et al. in 2014 [25] studied the Comparative study of muscle strengthening exercises for the treatment of chronic low backache. Their findings do support our results of increased Thoracolumbar ranges in the intra-group analysis with no difference in the inter-group analysis using modified Schober's test. Erector spine and multifidus group of muscles are more strengthened with floor than by Swiss ball exercise. Trunk mobilization in floor exercise results in contraction of global trunk stabilizing muscles. Local muscles are strengthened more in Swiss ball exercise thus producing segmental stability [13,25].

K. Senthil Kumar, K. Madhavi et al. 2014 [26] in their study investigated the Effectiveness of Floor Exercises Versus Swiss Ball Exercises on Core Stability in Subjects with Mechanical Low Back Pain.They came to a conclusion that with a five-week protocol there was a significant improvement of torque of spinal flexors and extensors, lumbar flexibility and pain reduction in both groups [15]. This improvement can be as a result of increased force demand of the muscle to overcome the heavier loads. As the center of gravity moves superiorly, the stability of body decreases becomes, as the center of gravity is a greater distance from the base of support [26].

This was also observed in our study where the mechanism for decreased activation of prime movers in the unstable conditions we employed could theoretically lead to increased stress associated with the postural demands. The body is a linked mechanical system, and it is necessary to provide a strong base of support before heavy weightlifting [15]. These could be probable reasons for insignificance noted in the intergroup analysis obtained in our study [27,28,29,30,31,32].

CONCLUSION

From the results of a present study, we conclude that: there is a similar effect of both Floor and Ball exercises on spinal mobility in Spastic Diplegic. Significant improvement was noted in the intra-group comparison of both the groups from baseline to post six-week Intervention as noted in the spinal mobility of Thoracolumbar spine using tape measurements and MMST. The important aspect being any form of intervention is necessary for a CP child than no intervention at all.

LIMITATIONS

There were a few limitations observed throughout the study conducted.

They are:

- A smaller sample size, therefore, the study cannot be generalized to the CP population.
- Rotation and side flexion of Thoracolumbar spine were not measured.

REFERENCE

[1] Sophie Levitt : Treatmenent of Cerebral Palsy and Motor Delay. 4th edition;2004.

[2] Shumway cook and woolacolt. Motor Control: Translating Research into Clinical Practice; 2007.

[3] Mark L. Latash & Francis Lestienne. Motor control and learning. 2006.

[4] T.K. Banerjee, et al. Neurological disorders in children and Adolescents. Indian J Pediatr. 2009 Feb;76(2):139-46.

[5] Chitra Sankar, Nandani Mundankar. Cerebral palsy : Definition , Classification, Aetiology and early diagnosis . Indian J Pediatr. 2005 Oct;72(10):865-8.

[6] Freeman miller. Physical therapy of cerebral palsy. 2007.

[7] Nadire BERKER Selim Yalçin. The HELP Guide to Cerebral Palsy.2nd edition;2010.

[8] Barbara H. Connolly, Patricia C. Montgomery. Therapeutic exercise in developmental disabilities. 3rd edition; 2005.

[9] Archie Hinchcliffe. Illustrations by Barbara Lynne Price and Clare Rogers Children with cerebral palsy: A manual for therapists, parents and community workers. 2nd edition 2007.

[10] Carol oatis: Kinesiology : The path mechanics and normal mechanics of human movement. 2nd edition; 2009.

[11] [11] Jeffrey m. willardson : Core stability training: applications to sports conditioning programs. J Strength Cond Res. 2007 Aug;21(3):979-85.

[12] Arthur steindler. Kinesiology of the Human Body Under Normal and Pathological Conditions.1977.

[13] Kissner and Colby. Therapeutic exercise Foundation and techniques. 6th edition; 2011.

[14] Hall and broody. Therapeutics Exercises. 2nd edition; 2007.

[15] Barbara hypes PT. Facilitating development and sensorimotor function treatment with ball. 1991.

[16] Sue Rayne, Linzi Meadows, Mary Lynch-Ellerington. Bobath Concept Theory and Clinical Practice in Neurological Rehabilitation. © 2009 by Blackwell Publishing Ltd

[17] Cynthia norkins: Joint structure and Function. 5th edition;2011.

[18] Mark D. Jakubel ATC. Stability Bails: Reviewing the Literature Regarding Their Use and Effectiveness. Strength and Conditioning Journ .2007;29(5):58-63.

[19] Susan. B. O' Sullivan and Thomas Schmitz. Physical rehaabilitaion.7th edition;2007.

[20] Garry t. Allison, sue l. Morris, Feedforward Responses of Transversus Abdominis Are Directionally Specific and Act Asymmetrically: Implications for Core Stability Theories. J Orthop Sports Phys Ther. 2008 May;38(5):228-37.

[21] Grenier SG, McGill SM. Quantification of lumbar stability by using 2 different abdominal activation strategies. Arch Phys Med Rehabil. 2007 Jan;88(1):54-62.

[22] Halpern AA, Bleck EE. Sit-up exercises: an electromyographic study. Clin Orthop Relat Res. 1979 Nov-Dec;(145):172-8.

[23] Mariana Felipe Silva et al. A comparative analysis

of the electrical activity of the abdominal muscles during traditional and Pilates- based exercises under two conditions. Rev Bras Cineantropom Desempenho Hum 2013, 15(3):296-304.

[24] Norwood JT, Anderson GS, Gaetz MB, Twist PW. Electromyographic activity of the trunk stabilizers during stable and unstable bench press. J Strength Cond Res. 2007 May;21(2):343-7.

[25] Soumya Ghosh, Soma Datta, Suravi Nayak, Arunima Chaudhuri, Pitchai Dhanasekaran. Comparative study of muscle strengthening exercises for treatment of chronic low backache. Med J DY Patil Univ 2014; 7:443-6.

[26] M. Rajesh, A. Viswanath Reddy, K. Senthil Kumar, K. Madhavi. Effectiveness of Floor Exercises Versus Swiss Ball Exercises on Core Stability in Subjects with Mechanical Low Back Pain.IJPOT.2014;8(1):75-80.

[27] Gauri Shankar, Vinod Chaurasia. Comparative Study of Core Stability Exercise with Swiss Ball in Improving Trunk Endurance. International Journal of Health Sciences & Research.2012;2(5):56-63.

[28] Jerrold S. Petrofsky et al. Core Muscle Activity During Exercise on a Mini Stability Ball Compared with Abdominal Crunches on the Floor and on a Swiss Ball. *The Journal of Applied Research.2007;7(3):255-272.*

[29] Kasee Hildenbrand, Larry Noble. Abdominal Muscle Activity While Performing Trunk-Flexion Exercises Using the Ab Roller, ABslide, FitBall, and Conventionally Performed Trunk Curls. J Athl Train. 2004 Jan-Mar; 39(1): 37–43.

[30] Joong-Hwi Kim, PhD, PT[1] and Hye-Jung Seo, MPH, PT[2,] Effects of trunk-hip strengthening on standing in children with spastic diplegia: a comparative pilot study. J Phys Ther Sci. 2015 May; 27(5): 1337–1340.

[31] Janet howle. The Neuro developmental treatment approach : theoretical foundations and principles of clinical practice. 2002.

[32] Stevens VK, Vleeming A, Bouche KG, Mahieu NN, Vanderstraeten GG, Danneels LA. Electromyographic activity of trunk and hip muscles during stabilization exercises in four-point kneeling in healthy volunteers. Eur Spine J. 2007 May; 16(5): 711–718.

Citation

Sakhawalkar, S., Paldhikar, S., Chitre, P., & Ghodey, S. (2017). EFFECTIVENESS OF FLOOR EXERCISES VERSES BALL EXERCISES ON SPINAL MOBILITY IN SPASTIC DIPLEGIC. *International Journal of Physiotherapy,* 4(2), 112-117.