Majalah Ilmiah Fisioterapi Indonesia
Indonesian Scientific Journal of Physiotherapy

Original Research Articles
ISSN (Print): 2303-1921
ISSN (Online): 2722-0443
Volume 14, Number 1, Pages 179-185 (2026)
DOI: https://doi.org/10.24843/mifi.000001273

Effects of Traditional Engklek Game on Static and Dynamic Balance in Preschool Children: A Quasi-Experimental Study

Rahadyani Ridha Mahdiyah[1], Mahendra Wahyu Dewangga[2], Rinna Ainul Maghfiroh[3]

[1-3]Department of Physiotherapy, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta, Surakarta, Indonesia

Corresponding author:
Name: Rahadyani Ridha Mahdiyah
E-mail: rahadyaniridha@gmail.com
Phone: +62 877-7626-5149

Received 22 January 2026; Revised 25 January 2026; Accepted 25 january 2026; Published 26 January 2026

Abstract

Background: Static and dynamic balance are essential components of motor development in preschool children, yet insufficient physical stimulation may impair balance acquisition during early childhood.

Objective: To evaluate the effect of the traditional engklek game on static and dynamic balance in preschool children aged 4–6 years.

Methods: A quasi-experimental pre-test–post-test control group study was conducted involving 36 preschool children (intervention n=18; control n=18). The intervention group participated in a modified engklek game three times per week for four weeks, while the control group followed routine school activities. Static balance was assessed using the One-Leg Stand Test (OLS) and dynamic balance using the 10-Meter Walk Test (10MWT). Data were analyzed using Wilcoxon Signed Rank and Mann–Whitney U tests (α=0.05), with effect sizes reported as r.

Results: The intervention group showed significant improvements in static balance (median OLS: 6.2 s to 11.4 s; p<0.001; r=0.62) and dynamic balance (median 10MWT: 9.1 s to 7.4 s; p<0.001; r=0.58), while no significant changes were observed in the control group. Between-group comparisons demonstrated significant differences in both outcomes (p<0.01).

Conclusion: The traditional engklek game significantly improves static and dynamic balance in preschool children aged 4–6 years and may serve as a feasible play-based intervention in pediatric physiotherapy.

Keywords
Postural Balance; Motor Skills; Play Therapy; Preschool Child

Introduction

Preschool age represents a critical period of rapid growth and development, during which fundamental motor abilities are established and refined. Children aged 4–6 years are in a sensitive phase of neuromotor maturation, often described as the golden age, characterized by accelerated development of cognitive, social–emotional, language, and motor domains.[1,2] Optimal motor development during this stage is essential because it forms the foundation for functional independence and participation in physical activities later in life. Adequate stimulation during early childhood is therefore necessary to support the maturation of basic motor skills and prevent delays that may persist into later developmental stages.[3]

One of the key components of motor development in early childhood is postural balance. Balance is defined as the ability to maintain the body's center of mass within the base of support through coordinated integration of the visual, vestibular, and proprioceptive systems.[4] This ability enables children to perform essential functional movements such as standing, walking, jumping, and running safely and efficiently.[5] From a developmental perspective, balance is commonly classified into static and dynamic components.[6] Static balance refers to the capacity to maintain body stability in a stationary position, such as standing on one leg, whereas dynamic balance involves maintaining postural control during movement, including walking, hopping, or running.[7,8] Insufficient development of either component may result in movement difficulties, reduced confidence during physical activity, and an increased risk of injury in childhood.[9]

Evidence from previous studies indicates that a proportion of preschool children exhibit delayed or suboptimal balance development. This condition is frequently associated with limited opportunities for active play, insufficient physical stimulation, and increasing sedentary behavior during early childhood.[10] Modern lifestyle patterns, including excessive screen time and reduced outdoor physical activity, may further restrict children's exposure to movements that challenge postural control and neuromuscular coordination. As a result, inadequate balance development during the preschool period may negatively influence gross motor skill acquisition and functional movement performance.[11]

Play-based physical activity is widely recognized as an effective and developmentally appropriate approach to stimulate motor skills in young children.[12] Traditional games, in particular, offer a natural, enjoyable, and culturally relevant medium for promoting physical activity while simultaneously fostering social interaction and motor learning.[13] Such games typically involve repetitive movements, changes in body position, and coordination demands that directly challenge postural control mechanisms. Consequently, traditional play has been increasingly explored as a low-cost and accessible strategy to enhance balance and motor competence in preschool children.[14]

Among traditional Indonesian games, engklek (hopscotch) is a popular activity that inherently requires balance, coordination, and concentration.[15] The game involves hopping on one foot, alternating between unilateral and bilateral support, and maintaining body stability while moving across predefined patterns.[16] These movements require continuous adjustment of the center of gravity and active engagement of the vestibular, proprioceptive, and visual systems. Through repeated practice, engklek provides dynamic sensory–motor stimulation that supports the development of postural control and neuromuscular coordination.[9,17]

Several studies have demonstrated the positive effects of engklek on children's motor development. Previous findings suggest that structured engklek-based interventions can significantly improve static and dynamic balance, gross motor skills, agility, and coordination.[18–21] For example, earlier research reported substantial improvements in balance performance following a four-week engklek intervention, with greater gains observed in static balance compared to dynamic balance.[22] Other studies have also shown that modified engklek patterns effectively enhance dynamic balance and postural stability in children. However, most existing studies have primarily focused on school-aged children (≥6 years) or evaluated motor development in a general manner without distinguishing between static and dynamic balance components.[23]

Despite growing evidence supporting the benefits of traditional games for motor development, research specifically examining the effects of engklek on static and dynamic balance in preschool children aged 4–6 years remains limited.[20] In addition, few studies have employed controlled quasi-experimental designs to evaluate balance outcomes separately during this critical developmental stage.[24,25] This lack of focused evidence highlights a clear research gap regarding the role of engklek as a balance-specific intervention for younger preschool populations.

Therefore, this study aimed to evaluate the effect of the traditional engklek game on static and dynamic balance in preschool children aged 4–6 years. It was hypothesized that participation in a structured engklek intervention would result in significant improvements in both static and dynamic balance compared to routine school activities.

Methods

This study employed a quasi-experimental observational design using a pre-test–post-test control group approach to evaluate the effect of a traditional engklek game intervention on static and dynamic balance in preschool children aged 4–6 years. The study was conducted at TK Al Huda Kerten under natural school conditions, where random allocation was not feasible.

Participants were recruited using purposive sampling based on predefined inclusion and exclusion criteria. The inclusion criteria were children aged 4–6 years who were actively enrolled at TK Al Huda Kerten, had no history of musculoskeletal, neurological, or developmental disorders that could affect balance or movement, and whose parents or legal guardians provided written informed consent. Children were excluded if they experienced illness or injury during the study period, did not complete the full intervention sessions, or had pathological balance disorders. A total of 36 children met the eligibility criteria and completed the study, with 18 children assigned to the intervention group and 18 children to the control group.

The sample size was determined pragmatically due to the limited number of eligible participants within the study setting. Nevertheless, this sample size was comparable to those used in previous quasi-experimental studies involving balance interventions in preschool populations. A post-hoc power analysis indicated that the sample provided a statistical power exceeding 80% to detect medium-to-large effect sizes at a significance level of $\alpha = 0.05$.

Intervention Procedure

The intervention group participated in a modified traditional engklek game designed to suit the developmental characteristics of preschool children. The intervention was conducted three times per week for four consecutive weeks, with each session lasting approximately 20 minutes. The traditional game was modified by eliminating the use of a *gacu* and emphasizing structured hopping and stepping patterns using the right foot, left foot, and both feet alternately across marked squares on the ground. These movements required participants to repeatedly maintain unilateral and bilateral support, control body alignment during landing, and transition between static and dynamic postural conditions.

Each session consisted of multiple repetitions of single-leg hopping, controlled landing, and transitional movements between squares, with short rest periods provided as needed to prevent fatigue. All intervention sessions were supervised by the researcher to ensure participant safety, correct execution of movements, and adherence to the intervention protocol. The implementation of the modified engklek intervention is illustrated in Figure 1**,** which demonstrates the activity setup and execution during the intervention sessions.

Figure 1. Implementation of the modified traditional engklek game as a balance intervention in preschool children.

The control group did not receive any specific balance training and continued to participate in routine school activities as usual, without additional structured physical exercises targeting balance.

Outcome Measures

Static and dynamic balance were defined as the primary outcome variables of this study. Static balance was operationally defined as the ability to maintain a stable unipedal stance and was measured using the One-Leg Stand Test (OLS). During the test, participants were instructed to stand on one leg for as long as possible, and the duration was recorded in seconds. Higher scores indicated better static balance performance. The procedure for the One-Leg Stand Test is illustrated in Figure 2a.

Dynamic balance was defined as the ability to maintain postural stability during gait and was assessed using the 10-Meter Walk Test (10MWT). Participants were instructed to walk a distance of 10 meters at a comfortable pace, and the time required to

complete the distance was recorded in seconds. Lower completion times indicated better dynamic balance and gait stability. The execution of the 10-Meter Walk Test is illustrated in Figure 2b.

Both instruments have demonstrated good validity and reliability in pediatric populations. The One-Leg Stand Test has been reported to show excellent test–retest reliability in children, with intraclass correlation coefficients (ICC) ranging from 0.87 to 0.92, while the 10-Meter Walk Test demonstrates high reliability, with ICC values between 0.90 and 0.96.

Figure 2a. One-Leg Stand Test for assessing static balance

Figure 2b. 10-Meter Walk Test for assessing dynamic balance.

Data Collection Procedure

Data collection was conducted in three stages: pre-test, intervention, and post-test. Baseline measurements of static and dynamic balance were obtained for both the intervention and control groups prior to the intervention period. Following the four-week intervention, post-test measurements were conducted using the same instruments and standardized procedures. To minimize measurement bias, all assessments were performed by the same trained assessor, and consistent instructions were provided to all participants across measurement sessions.

Statistical Analysis

Statistical analysis was performed using SPSS version 27. Data normality was assessed using the Shapiro–Wilk test, and homogeneity of variance was examined using Levene's test. As several outcome variables did not meet the assumptions of normality, non-parametric statistical tests were applied. Within-group comparisons between pre-test and post-test measurements were analyzed using the Wilcoxon Signed Rank Test, while between-group differences were examined using the Mann–Whitney U Test. The level of statistical significance was set at $\alpha = 0.05$. Effect sizes were calculated using the r statistic for non-parametric tests and interpreted as small (0.10), moderate (0.30), or large (≥0.50), allowing evaluation of both statistical and clinical relevance of the intervention effects.

Results

A total of 36 preschool children aged 4–6 years completed the study and were included in the final analysis, consisting of 18 children in the intervention group and 18 children in the control group. All participants completed the pre-test and post-test assessments, and no dropouts were recorded during the four-week intervention period. The demographic characteristics of the participants are presented in Table 1 and Table 2.

The flow of participants through the study is presented in Figure 2. A total of 36 preschool children aged 4–6 years were assessed for eligibility. All eligible participants met the inclusion criteria and were allocated to either the intervention group (n = 18) or the control group (n = 18). All participants completed the intervention period and post-test assessments, and no dropouts were recorded during the study.

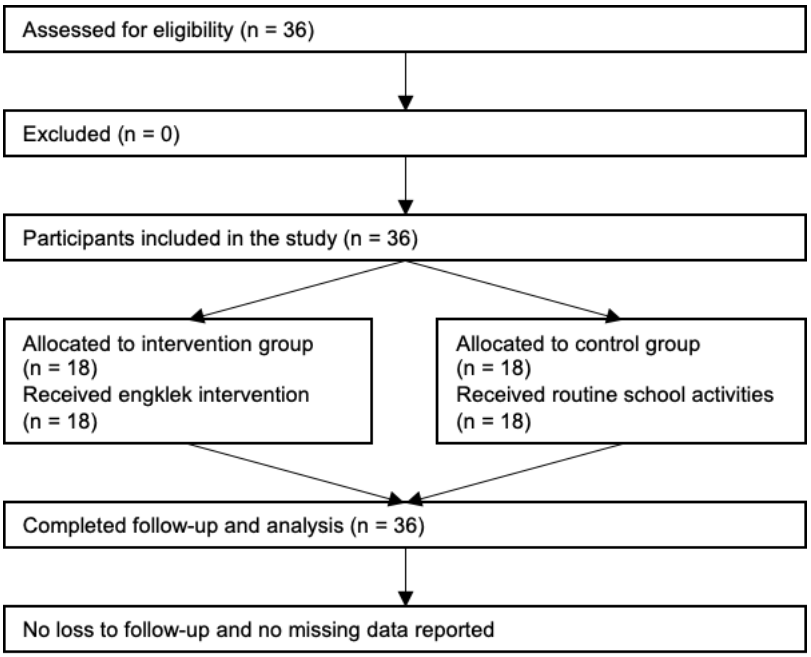

Figure 2. Flow diagram of participant recruitment and allocation in the quasi-experimental study.

Participant Characteristics

Table 1. Age Distribution of Participants by Sex

Sex	n	Mean Age (years)	SD	Minimum	Maximum
Boys	17	5.09	0.54	4.3	6.0
Girls	19	5.12	0.67	4.1	6.0

As shown in Table 1, the mean age of boys and girls was comparable, with both groups centered around 5 years of age, indicating a homogeneous age distribution among participants.

Table 2. Distribution of Participants by Class and Sex

Class	Boys	Girls	Total
A	11	9	20
B	6	10	16
Total	17	19	36

As presented in Table 2, participants were distributed across two classes with a relatively balanced representation of boys and girls. No substantial imbalance in sex distribution was observed between classes.

Static Balance Outcomes

Static balance was assessed using the One-Leg Stand Test (OLS). Descriptive statistics and within-group analyses of OLS performance are summarized in Table 3.

Table 3. Static Balance (One-Leg Stand Test) Pre-test and Post-test Results

Group	Median Pre-test (s)	Median Post-test (s)	Z	p-value	Effect Size (r)
Intervention	6.2	11.4	−3.419	<0.001	0.62
Control	6.5	6.7	−0.501	0.616	0.08

As shown in Table 3**,** the intervention group demonstrated a significant improvement in static balance following the engklek intervention, with median OLS values increasing from 6.2 seconds to 11.4 seconds ($p<0.001$). The magnitude of this change was supported by a large effect size ($r=0.62$). In contrast, the control group did not show a significant change in OLS performance between pre-test and post-test ($p=0.616$). Between-group comparison of post-test OLS scores using the Mann–Whitney U test revealed a statistically significant difference favoring the intervention group ($U=80.000$; $Z=-2.594$; $p=0.009$).

Dynamic Balance Outcomes

Dynamic balance was evaluated using the 10-Meter Walk Test (10MWT). Pre-test and post-test results for dynamic balance are presented in Table 4.

Table 4. Dynamic Balance (10-Meter Walk Test) Pre-test and Post-test Results

Group	Median Pre-test (s)	Median Post-test (s)	Z	p-value	Effect Size (r)
Intervention	9.1	7.4	−3.354	<0.001	0.58
Control	9.3	9.0	−1.823	0.068	0.30

As indicated in Table 4, the intervention group showed a significant improvement in dynamic balance, demonstrated by a reduction in median 10MWT completion time from 9.1 seconds to 7.4 seconds ($p<0.001$), with a large effect size ($r=0.58$). The control group did not exhibit a statistically significant change in dynamic balance over the study period ($p=0.068$). Between-group analysis confirmed a significant difference in post-test 10MWT performance between the intervention and control groups ($U=77.500$; $Z=-2.674$; $p=0.008$).

Summary of Results

Overall, the results presented in Tables 3 and 4 demonstrate that the traditional engklek game intervention led to significant improvements in both static and dynamic balance among preschool children aged 4–6 years. No comparable improvements were observed in the control group, indicating that the observed changes were primarily attributable to the engklek intervention.

Discussion

The present study demonstrated that participation in a traditional engklek game intervention resulted in significant improvements in both static and dynamic balance among preschool children aged 4–6 years. Children in the intervention group showed markedly better post-intervention performance on the One-Leg Stand Test and the 10-Meter Walk Test compared with their baseline values, whereas no significant changes were observed in the control group. These findings indicate that the observed balance improvements were primarily attributable to the engklek intervention rather than to routine school activities alone.

The improvement in static balance observed in this study, reflected by a substantial increase in One-Leg Stand Test duration and a large effect size, suggests meaningful enhancement in the children's ability to maintain postural stability during stationary tasks.[26] From a clinical perspective, improved static balance in preschool children is associated with better control of the center of mass over a reduced base of support, which is essential for fundamental motor skills such as standing, hopping, and transitioning between postures.[27] The repetitive single-leg hopping and controlled landing movements inherent in the engklek game likely stimulated postural muscles and enhanced neuromuscular coordination, thereby improving static balance performance.[28] These findings are consistent with previous studies reporting significant gains in static balance following engklek-based or play-based balance interventions in children.[29,30,31]

In addition to static balance, the engklek intervention also led to significant improvements in dynamic balance, as indicated by reduced completion times in the 10-Meter Walk Test and a large effect size.[22] Dynamic balance requires continuous postural adjustments during movement, relying on the integration of vestibular, proprioceptive, and visual inputs. The engklek game involves frequent transitions between unilateral and bilateral support, directional changes, and rhythmic hopping movements, all of which challenge postural control during locomotion.[32] Repeated exposure to these movement demands may enhance anticipatory and reactive postural control mechanisms, thereby improving gait stability and dynamic balance in preschool children.[33] This finding aligns with earlier studies showing that traditional games and play-based interventions can effectively enhance dynamic balance and locomotor performance in young children.[34,35]

When compared with existing literature, the results of this study extend previous findings by providing evidence specific to preschool-aged children and by differentiating between static and dynamic balance outcomes. While many prior studies have focused on school-aged children or assessed motor development globally, the present study highlights that balance-specific improvements can already be achieved in children aged 4–6 years through structured traditional play. This is particularly important given that early childhood represents a critical window for neuromotor development, during which targeted stimulation may yield long-term benefits for motor competence and physical activity participation.

Despite these positive findings, several methodological considerations should be acknowledged. First, the quasi-experimental design without random allocation may introduce selection bias, as group assignment was determined by practical considerations within the school setting. Although baseline characteristics between groups were comparable, unmeasured confounding factors, such as differences in habitual physical activity outside of school or variations in home environments, may have influenced the outcomes. Second, the sample size was relatively small and drawn from a single preschool, which may limit the generalizability of the findings. Therefore, the results should be interpreted with caution and primarily generalized to preschool populations with similar characteristics and settings.

Another limitation relates to the short duration of the intervention and the absence of long-term follow-up. While significant improvements were observed after four weeks, it remains unclear whether these gains would be maintained over time without continued practice. Additionally, assessor blinding was not feasible in the present study, which may have introduced measurement bias, although standardized testing procedures and the use of validated instruments were applied to minimize this risk.

From a practical standpoint, the findings of this study suggest that the traditional engklek game may be incorporated as a feasible and enjoyable play-based intervention to enhance balance in preschool children. The intervention requires minimal equipment, is low-cost, and can be easily implemented in school or community settings. For pediatric physiotherapy practice, engklek may serve as an adjunct or alternative approach to conventional balance training, particularly for young children who benefit from engaging and culturally relevant activities. Based on the present protocol, implementing engklek sessions approximately three times per week for 20 minutes may provide meaningful balance benefits for preschool-aged children.

Future research is recommended to employ randomized controlled designs with larger and more diverse samples to strengthen causal inference and improve external validity. Longitudinal studies are also needed to evaluate the sustainability of balance improvements and to explore the potential transfer effects of engklek-based interventions on other motor domains, such as coordination, agility, and functional movement skills. By addressing these aspects, future studies may further clarify the role of traditional games in supporting early childhood motor development and preventive pediatric physiotherapy.

Conclusion

This study demonstrates that participation in a traditional engklek game intervention significantly improves both static and dynamic balance in preschool children aged 4–6 years. Children who received the engklek intervention showed meaningful improvements in One-Leg Stand Test and 10-Meter Walk Test performance compared with those who participated only in routine school activities, indicating that structured traditional play can effectively enhance balance abilities during early childhood.

Despite these positive findings, the results should be interpreted in light of the study's limitations, including the quasi-experimental design without randomization, the relatively small sample size, and the absence of long-term follow-up. Therefore, causal inferences should be made cautiously, and generalization of the findings should be limited to preschool populations with similar characteristics and settings.

From a practical perspective, the traditional engklek game represents a simple, low-cost, and enjoyable play-based intervention that may be integrated into pediatric physiotherapy programs or school-based physical activities. Based on the present protocol, implementing engklek sessions approximately three times per week for 20 minutes may provide beneficial effects on balance development in preschool children.

Author Contribution

Rahadyani Ridha Mahdiyah: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft.
Mahendra Wahyu Dewangga: Methodology, Formal analysis, Writing – review & editing.
Rinna Ainul Maghfiroh: Conceptualization, Supervision, Writing – review & editing.
All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

Acknowledgments

The author would like to express sincere gratitude to the teachers, children, and parents or guardians of TK Al Huda Kerten for their cooperation and participation in this study. Appreciation is also extended to all parties who provided support during the data collection process.

Conflict of Interest Statement

The author declares that there is no conflict of interest related to this study.

Funding Sources

This research received no external funding.

Ethics Statement

This study was approved as an ethical exemption by the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Surakarta (No. 1535/KEPK-FIK/IX/2025). Written informed consent was obtained from the parents or legal guardians of all participants prior to data collection. All procedures were conducted in accordance with ethical principles for research involving human participants, including confidentiality, voluntary participation, and child safety.

References

1. Retnoningdiah M, Alfitri R, Ilmiah WS. Differences in gross motor skills of preschool children aged 5-6 years before and after playing the traditional engklek game. *Health Dyn*. 2024;1(4):111–116.
2. Mayar F, Sriandila R. Pentingnya mengembangkan fisik motorik anak sejak dini. *Pendidik Tambusai*. 2021;5(3):9769–75.
3. Putra AD, Murniati S, Yusradinafi. Keterampilan teknik dasar passing peserta ekstrakurikuler sepakbola pada sekolah menengah pertama. *J Cerdas Sifa Pendidik*. 2023;12:13–21.
4. Kusumaningtyas P, Yulianti A, Rahmawati NA. Comparative analysis of balance based on gender in children aged 10-12 years at Muhammadiyah 08 Dau elementary school. *J Keperawatan Fisioterapi (JKF)*. 2024;7(1):54–60.
5. Schedler S, Graf SM, Muehlbauer T. Effects of different balance training volumes on children's dynamic balance. *Sports Med Int Open*. 2022;6(1):E32–E38.
6. Fauziah E, Zulfah K, Oktaviani YE. Penatalaksanaan fisioterapi untuk meningkatkan keseimbangan dinamis lansia dengan core stability exercise dan tandem walking exercise. *FISIO MU Physiother Evid*. 2021;3(1):16–22.
7. Nurfadilah RA. Anak tuna grahita menggunakan metode tes. 2024;13(2):216–28.
8. Hairan N, Nasirudin Y. Perbedaan pengaruh dual-task training dengan permainan tradisional engklek terhadap keseimbangan dinamis anak flat foot usia sekolah di SDN Jatimekar II. *Physiother Health Sci (PhysioHS)*. 2024;7(2):64–72.
9. Adi INAN, Pramita I, Vitalistyawati LPA. Pengaruh permainan tradisional engklek terhadap keseimbangan statis dan dinamis pada anak usia 6-12 tahun di lingkungan Padang Keling Kelurahan Banyuning Buleleng Bali. *J Pendidik Kesehat Rekreasi*. 2022;8(1):56–63.
10. Jannah SR, Muharram NA, Herpandika RP, Setiawan I. Development of a traditional game "engklek" based on numeracy literacy to improve locomotor movements of elementary school students. *Traditional Games Int J*. 2024;2(2):49–57.
11. Rais SS, Sit M. Meningkatkan keterampilan motorik kasar anak usia 5-6 tahun melalui permainan engklek. *J Educ Res*. 2024;5(3):3731–9.
12. Zeng N, Ayyub M, Sun H, Wen X, Xiang P, Gao Z. Effects of physical activity on motor skills and cognitive development in early childhood: a systematic review. *Biomed Res Int*. 2017;2017:1–13.
13. Hassani F, Afazeli Z. Be more active with traditional games: traditional review. *Turk Klin J Sports Sci*. 2024;16(1):119–28.
14. Maudina SA, Khasanah I. Aktivitas bermain engklek sebagai stimulasi keseimbangan tubuh anak usia dini. *Semin Nas Transisi*. 2023: pages not available.
15. Zuhri Z, Dewi SV, Kusuma JW, Rafiqoh S, Mahuda I, Hamidah H. Implementation of ethnomathematics strategy in Indonesian traditional games as mathematics learning media. *J Innov Educ Cult Res*. 2023;4(2):294–302.
16. Saudah S, Muzakki M, Noviyanti LF. Melatih keseimbangan anak melalui permainan engklek di TK Harapan Bangsa. *Edu Happiness J Ilm Perkemb Anak Usia Dini*. 2025;4(2):196–206.
17. Ali M, Aqobah QJ. Students through the modification of engklek. *Stud Trad Games Educ Res*. 2020;6(1):pages not available.
18. Salsabela U, Yuniarti Y, Maulina I. Penerapan permainan engklek dalam menstimulasi kemampuan motorik kasar anak kelas B TK Mekar Mentari Gemilang. *Ta'rim J Pendidik Anak Usia Dini*. 2025;6(1):277–89.
19. Sukoyo J, Kurniati E, Utami ES. Engklek game and its benefits for early children's development. *Int J Early Child Spec Educ*. 2021;13(1):20–7.
20. Hasibuan R, Jannah M. Traditional game "engklek" and young children's gross motor ability. In: *Proc Int Conf Early Child Educ (ICECE 2017)*. Paris: Atlantis Press; 2018. p. pages not available.
21. Wiranti DA, Mawarti DA. Keefektifan permainan engklek dalam mengembangkan kemampuan motorik kasar anak usia dini. *Refleksi Edukatika J Ilm Kependidik*. 2018;9(1):pages not available.
22. Hudha M, Wahyudi AN, Darumoyo K. The effect of engklek on improved balance in fourth grade children at Kiyonten State Elementary School 1. *Competitor J Pendidik Kepelatihan Olahraga*. 2022;14(2):206–?
23. Conner BC, Petersen DA, Pigman J, Tracy JB, Johnson CL, Manal K, et al. Cross-sectional relationships between age, standing static balance and standing dynamic balance reactions in typically developing children. *Gait Posture*. 2019;73:20–5.
24. Muehlbauer T, Brueckner D, Schedler S. Effect of practice on learning a balance task in children, adolescents, and young adults. *Front Psychol*. 2022;13:pages not available.

25. Abuín-Porras V, Jiménez Antona C, Blanco-Morales M, Palacios A, Romero-Morales C, López-López D, et al. Could a multitask balance training program complement balance training in healthy preschool children: a quasi-experimental study. *Appl Sci*. 2020;10(12):4100.
26. Muehlbauer T. Effects of balance training on static and dynamic balance performance in healthy children: role of training duration and volume. *BMC Res Notes*. 2021;14(1):465.
27. Gutschow S, Kranz DD, Tamm S, Papke A, Kotzsch A, Kraemer JF, et al. Promoting motor skills in preschool age: a focus on balance regulation. *Physiol Meas*. 2025;46(4):045005.
28. Raharjo S, Kurniawan H. Effects of 16-weeks traditional game intervention increase static balance of deaf students in SLB-B Yayasan Pendidikan Tunas Bangsa Malang. *Int J Res Publ*. 2022;93(1):pages not available.
29. *Duplicate of 16* Saudah S, Muzakki M, Noviyanti LF. [Removed; duplicate entry].
30. Harianti NP, Marbun S, Situmorang SMA. Pengaruh permainan tradisional engklek terhadap motorik kasar anak usia 5-6 tahun di TK Amir Hamzah Medan. *J Educ Media Inform Sci*. 2024;13(1):33–40.
31. Nuraini I, Nufus H, Ma M. The influence of traditional engklek game in training gross motor balance in early childhood at Labschool Syekh Manshur Kindergarten. *Child Develop Stud J*. 2025;pages not available.
32. Paramesthi R, Soegiyanto S, Pramono H. The effect of modifications of challenge board games and traditional engklek games on locomotor movement in mild children. *Juara J Olahraga*. 2022;7(3):733–40.
33. Cimochowska E, Siatkowski I, Wójcik M. Evaluation of the effect of postural muscle strengthening exercises on static and dynamic balance in preschool children. *Fizjoterapia Polska*. 2025;25(2):92–6.
34. Meliniawati PFS, Wahyudi AT, Sari NLMRW, Kharismawan PM. Modifikasi pola permainan engklek memengaruhi keseimbangan dinamis anak umur 6-8 tahun: pra-eksperimental. *Majalah Ilmiah Fisioterapi Indonesia*. 2023;11(2):208.
35. Nurdiyanti F, Naqiyah B. Efektivitas permainan tradisional engklek dalam melatih keseimbangan (motorik kasar) anak usia 4–5 tahun. *Starkids J Pendidik Anak Usia Dini*. 2025;1(1):1–11.