**Tunas Cendekia: Jurnal Program Studi Pendidikan Anak Usia Dini**
P-ISSN 2622-0849 E-ISSN 2654-6051
Website: https://ejournal.iainpalopo.ac.id/index.php/tunascendekia
DOI: https://doi.org/10.24256/cendekia.v9i2.12208
Vol. 9, No. 2, 2026, pp. 1753–1762

# Changes in Motor and Sensory Development Following Complementary Massage Therapy in Children Aged 4–6 Years

**Yaumil Fauziah[1], Yulia Safitri[2], Yulia Fatma Nasution[3]**
[1,2,3] Sekolah Tinggi Ilmu Kesehatan Flora, Medan, Indonesia

## Abstract

Preschool age is a critical developmental period in which motor coordination, sensory processing, and adaptive responses become increasingly refined and support learning, independence, play, and participation in daily activities. Appropriate stimulation may strengthen developmental achievement and children's responses to environmental demands. Complementary massage therapy has been considered a non-pharmacological stimulation that provides tactile, proprioceptive, and relaxation-related input. This study examined changes in motor and sensory development following complementary massage therapy among children aged 4–6 years. A quantitative quasi-experimental one-group pretest-posttest study was conducted at TK Aisyiyah Bustanul Athfal (ABA) Batangtoru, North Sumatra, Indonesia. Forty preschool children completed all stages of the study. Motor and sensory development were assessed before and after a structured complementary massage intervention using the same outcome measures. Paired-samples t tests were used to compare pretest and posttest scores, while Cohen's dz was calculated to estimate effect size. The mean motor development score increased from 68.13 (SD = 4.76) to 82.50 (SD = 7.16), with a mean increase of 14.38 points, $t(39) = 11.01$, $p < .001$, Cohen's dz = 1.74. Sensory development increased from 63.13 (SD = 4.03) to 81.13 (SD = 4.46), with a mean increase of 18.00 points, $t(39) = 21.06$, $p < .001$, Cohen's dz = 3.33. These findings indicate statistically significant and large improvements in both outcomes. Complementary massage may serve as supportive developmental stimulation when delivered safely by trained personnel and integrated with age-appropriate educational activities. However, the absence of a control group limits causal interpretation. Future studies should use controlled multisite designs, validated assessment instruments, larger samples, and longer follow-up periods. These approaches are needed to determine whether observed improvements persist over time and represent clinically meaningful benefits for children.

**Keywords:** complementary massage; motor development; sensory development; preschool children; early childhood education

**Corresponding Author**
Yaumil Fauziah, Sekolah Tinggi Ilmu Kesehatan Flora Medan
Email: yaumil.fauziah9@email.com

**Article Information**
Received: 2 July 2026
Accepted: 24 September 2026
Published: 2 October 2026

**© 2026 Tunas Cendekia: Jurnal Program Studi Pendidikan Anak Usia Dini.** This article is published under the Creative Commons. Attribution–ShareAlike 4.0 International License (CC BY-SA 4.0).
https://creativecommons.org/licenses/by-sa/4.0

## 1. Introduction

Children aged 4–6 years are in a developmental period in which increasingly coordinated movement, balance, hand use, body awareness, and responses to sensory input become closely linked to participation in play and learning. Early childhood development is shaped by repeated interactions between biological maturation and responsive environmental experiences. International guidance emphasizes responsive caregiving, opportunities for early learning, and safe and secure environments as important conditions for supporting children's developmental potential. (WHO, 2018) Evidence from parenting and stimulation programs also shows that intentional developmental support can improve motor and other early developmental outcomes, although effects differ according to program content, context, and measurement approach (Jeong et al., 2021)

Motor competence during the preschool years includes locomotor control, object manipulation, postural stability, and increasingly refined fine-motor coordination. These skills do not develop at the same rate in every child and are sensitive to practice opportunities. Global and systematic evidence indicates substantial variability in fundamental motor skill competence, while structured or development-focused activities can improve preschool motor (Bolger et al., 2021) Studies of active play,

playground activity, physical literacy, and educator-supported movement programs further demonstrate that repeated, age-appropriate stimulation is relevant to motor learning in preschool settings (Stevenson et al., 2023). Motor development also has functional relevance beyond movement itself because motor competence supports participation, play, and learning experiences (Flores et al., 2023) (Jones et al., 2020)

Sensory development refers to the child's ability to register, organize, and respond to information received through sensory systems, including tactile, proprioceptive, vestibular, auditory, and visual input. Sensory responses influence how children engage with materials, people, movement, and classroom routines. Assessment therefore needs to distinguish sensory patterns from general behavior and should use an age-appropriate instrument with a clear scoring interpretation (Shahbazi, 2021). Recent psychometric studies have continued to examine the validity of commonly used sensory questionnaires and reinforce the need to interpret scores according to the construct and context measured rather than assuming that a higher raw score always indicates a better outcome (Gándara-Gafo & Beaudry-Bellefeuille, 2023; Jones et al., 2024). In Indonesia, early sensory stimulation has also been identified as an important responsibility of parents and early childhood educators for children aged 4-6 years (Meilanie, 2021).

Massage therapy provides structured tactile input through touch, pressure, and movement. In pediatric practice, massage has been studied as a complementary intervention rather than a replacement for medical, developmental, or educational services. (Wang & Zhou, 2024) An umbrella review reported potential benefits of pediatric massage for several physical and developmental outcomes in young children, although the certainty of evidence was limited by methodological heterogeneity and insufficient adverse-event reporting (Chen et al., 2024b) (Lu et al., 2019) reported improvements in motor and sensory-related outcomes after a 12-week massage program among young children with developmental delay. In other clinical populations, massage has been associated with changes in gross motor function or tactile-related outcomes, although those findings cannot be directly generalized to typically developing preschool children (Fadlalmola, 2024); (Mahmood et al., 2024)

Indonesian studies provide additional contextual support for examining touch-based stimulation. Infant massage has been associated with gross motor improvement or developmental stimulation in several local studies and reviews, but most participants were infants rather than preschool children (Jannah et al., 2025) (Kristianingrum et al., 2022) (Rahmadani et al., 2025). Other early childhood interventions in Indonesia, including movement-and-song learning and structured fine-motor stimulation, also suggest that repeated sensorimotor experiences can support developmental performance (Mayar et al., 2022); (Wahyuningrum & Watini, 2022)These studies are relevant as background but leave an important age and context gap for children aged 4-6 years in kindergarten settings.

The present study addresses this gap by evaluating motor and sensory scores before and after a structured complementary massage program among children aged 4-6 years at TK Aisyiyah Bustanul Athfal (ABA) Batangtoru. The study focuses on two related developmental outcomes within the same preschool population and reports both statistical significance and effect size. The research objective was to determine whether motor and sensory scores differed significantly between pretest and posttest measurements following the massage program. Its novelty lies in examining complementary massage within a preschool educational context rather than focusing primarily on infants or narrowly defined clinical populations. This study therefore aimed to examine changes in motor and sensory development following complementary massage therapy among children aged 4–6 years. It was hypothesized that motor and sensory development scores would be significantly higher at posttest than at pretest following the intervention.

## 2. Methodology

This study used a quantitative quasi-experimental approach with a one-group pretest-posttest design. The design was selected to examine within-child changes in motor and sensory scores across two measurement occasions surrounding the massage intervention. Because the study did not include randomization or a parallel control group, the design estimates pretest-posttest change but cannot fully separate the intervention from maturation, repeated testing, concurrent classroom activities, or other time-related influences (Creswell, 2017)

The study was conducted at TK Aisyiyah Bustanul Athfal (ABA) Batangtoru, Batangtoru District, South Tapanuli Regency, North Sumatra, Indonesia. A total of 45 children were initially screened for eligibility. Of these, 42 met the eligibility criteria and were enrolled in the study, while three were excluded for not meeting the eligibility criteria. During the intervention period, two participants discontinued participation and did not complete the posttest assessment. Therefore, the final analytic sample consisted of 40 children who completed the pretest, the 12-week intervention, and the posttest assessment. During the intervention period, two participants were lost to follow-up and did not complete the posttest assessment. Twelve children were aged 4 years, 15 were aged 5 years, and 13 were aged 6 years. Eighteen participants were boys and 22 were girls. Participants were selected according to the study's eligibility criteria. Children were required to be actively enrolled, physically able to participate in the assessment and massage sessions, and to have parent or guardian permission. Sessions were postponed or discontinued when a child was unwell, had an active skin problem in the massage area, reported pain, or did not wish to continue.

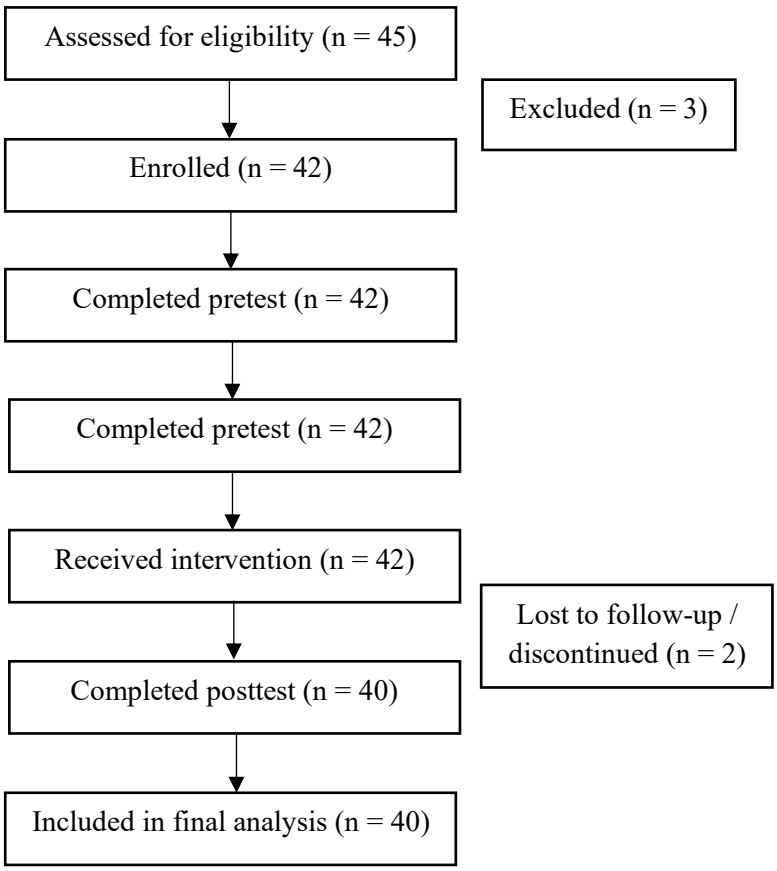



**Figure 1**
Study flow diagram

The intervention consisted of structured pediatric massage positioned as complementary developmental stimulation. Each session lasted approximately 20 minutes and was scheduled twice weekly for 12 weeks. The procedure used gentle, structured touch and pressure on the extremities, back, shoulders, palms, and soles according to the study's standard operating procedure. The dosage was adapted from prior pediatric massage research that used repeated 20-minute sessions over 12 weeks (Lu et al., 2019), while the application in this preschool population was designed to remain child-friendly and non-coercive. Motor development was assessed using the Kuesioner Pra Skrining Perkembangan (KPSP), an age-specific developmental screening instrument covering four domains: gross motor skills, fine motor skills, speech and language, and socialization and independence. Each age-specific KPSP form consists of 10 dichotomous items answered "Yes" or "No." Higher scores indicate a greater number of age-appropriate developmental abilities demonstrated by the child. (Safitri et al., 2024) (KEMENKES, 2025)

Sensory processing was assessed using the Child Sensory Profile 2 (SP2; Dunn, 2014), a standardized caregiver-report questionnaire designed for children aged 3 years 0 months to 14 years 11 months. The instrument consists of 86 items covering four sensory-processing quadrants—Seeking, Avoiding, Sensitivity, and Registration—and nine sensory and behavioral sections: Auditory Processing, Visual Processing, Touch Processing, Movement Processing, Body Position Processing, Oral Sensory Processing, Conduct, Social-Emotional Responses, and Attentional Responses associated with sensory processing. Responses are rated according to the frequency of the child's sensory-related behaviors, ranging from Almost Never to Almost Always. Raw scores are interpreted using normative cut scores and percentile bands rather than assuming that a higher total score necessarily represents better sensory development. (Safitri et al., 2024) (KEMENKES, 2025). Throughout the intervention period, no sessions were stopped because of discomfort, pain, distress, or refusal, and all completed sessions were tolerated without reported adverse events. Pediatric massage was used as an adjunct to routine educational activities, not as a substitute for active play or developmentally appropriate learning experiences. (Licciardi & Brown, 2023) (Gándara-Gafo & Beaudry-Bellefeuille, 2023)

Motor and sensory development were measured immediately before and after the intervention period using the study's structured assessment instruments. The motor outcome was recorded as a continuous composite score, and the sensory outcome was recorded as a separate continuous composite score. The same scoring procedure was applied at pretest and posttest. The dataset supplied for analysis contained the final composite scores used in the statistical tests. Developmental status was assessed using the Kuesioner Pra Skrining Perkembangan (KPSP; Developmental Pre-Screening Questionnaire), an age-specific developmental screening instrument used within the Indonesian child-development monitoring system. The KPSP assesses four developmental domains: gross motor skills, fine motor skills, speech and language, and socialization and independence. Responses are recorded dichotomously as "Yes" or "No," with higher numbers of achieved items reflecting a greater number of age-appropriate developmental milestones. The appropriate KPSP form was selected according to each child's chronological age. Published diagnostic evaluation of the Indonesian KPSP against the Denver II reported an overall sensitivity of 68.8%, specificity of 86.6%, and accuracy of 81.9% (Simangunsong et al., 2012); however, diagnostic performance was lower among older children, and this limitation was considered when interpreting the present findings.

Sensory processing was assessed using the Child Sensory Profile 2 (CSP-2; Dunn, 2014), a standardized caregiver-report instrument designed for children aged 3 years 0 months to 14 years 11 months. The CSP-2 evaluates four sensory-processing patterns—Seeking, Avoiding, Sensitivity, and Registration—together with sensory sections addressing auditory, visual, touch, movement, body position, and oral sensory processing, and behavioral sections addressing conduct, social-emotional, and attentional responses associated with sensory processing. Pearson specifies that CSP-2 scores are

interpreted using normative classifications rather than as a simple continuum in which higher scores represent better sensory function. Scores are classified relative to normative expectations, including patterns such as *Much Less Than Others, Less Than Others, Just Like the Majority of Others, More Than Others,* and *Much More Than Others*

This is especially important for sensory instruments because raw-score direction differs across standardized measures (Gándara-Gafo & Beaudry-Bellefeuille, 2023); (Shahbazi, 2021).

Data were analyzed using SPSS. Descriptive statistics included frequency and percentage for participant characteristics and mean with standard deviation for motor and sensory scores. Pretest-posttest differences were analyzed separately for the motor and sensory outcomes using paired-samples t tests. Statistical significance was set at $p < .05$. SPSS values reported as .000 were presented as $p < .001$ following APA 7th Edition conventions. Mean differences and 95% confidence intervals were reported in the posttest-minus-pretest direction for ease of interpretation. Effect size was calculated as Cohen's dz using the paired t statistic divided by the square root of the sample size. Before conducting the paired-samples t tests, the normality of the pretest-to-posttest difference scores was assessed separately for motor and sensory outcomes using the Shapiro-Wilk test and visual inspection of Q-Q plots. The paired-samples t test was retained when the distribution of the difference scores was considered approximately normal. A two-sided significance level of $p < .05$ was used for all statistical analyses. The normality of the pretest-posttest difference scores was assessed separately for motor and sensory outcomes using the Shapiro-Wilk test and visual inspection of Q-Q plots before conducting the paired-samples t tests. The distributions of the difference scores showed no substantial deviation from normality, supporting the use of paired-samples t tests.

Ethical approval from an institutional ethics committee was not obtained prior to the commencement of the study. However, permission to conduct the study was obtained from TK Aisyiyah Bustanul Athfal (ABA) Batangtoru, and written informed consent was obtained from the parents or legal guardians of all participating children. Age-appropriate assent was obtained from the children, participation was voluntary, and children were allowed to refuse or discontinue participation at any time. Participant confidentiality was maintained through coded identifiers. The absence of prior formal ethical committee approval is acknowledged as a limitation of the study.

Ethical procedures included institutional permission, parental or guardian informed consent, age-appropriate child assent, confidentiality of participant data, and the child's right to stop participation at any time. Identifiers were replaced with codes in the analytic dataset. Any unexpected response during or after massage was to be documented and reviewed, consistent with the growing emphasis on safety reporting in pediatric massage research (Chen et al., 2024b) No unexpected or adverse responses were observed during or after the complementary massage sessions. No participants experienced pain, distress, skin irritation, or other intervention-related adverse events, and no sessions were terminated for safety-related reasons.

## 3. Results

Forty children completed all study stages. The largest age group was 5 years (37.5%), followed by 6 years (32.5%) and 4 years (30.0%). Girls represented 55.0% of the sample and boys 45.0%. Table 1 summarizes the participant characteristics.

**Table 1**

Characteristic

| Characteristic | Category | n | % |
|---|---|---|---|
| Age | 4 years | 12 | 30.0 |
| Age | 5 years | 15 | 37.5 |
| Age | 6 years | 13 | 32.5 |

| | | | |
|---|---|---|---|
| Sex | Boy | 18 | 45.0 |
| Sex | Girl | 22 | 55.0 |

Motor scores increased from M = 68.13 (SD = 4.76) at pretest to M = 82.50 (SD = 7.16) at posttest. The mean posttest-minus-pretest difference was 14.38 points. The paired-samples t test showed a statistically significant difference, t(39) = 11.01, p < .001, with a 95% confidence interval for the mean increase from 11.73 to 17.02 points. Cohen's dz was 1.74, indicating a large standardized within-participant change.

Sensory scores also increased, from M = 63.13 (SD = 4.03) at pretest to M = 81.13 (SD = 4.46) at posttest. The mean increase was 18.00 points. The paired-samples t test showed a statistically significant difference, t(39) = 21.06, p < .001, with a 95% confidence interval from 16.27 to 19.73 points. Cohen's dz was 3.33. Table 2 presents the descriptive and inferential statistics for both outcomes.

**Table 2**

Pretest-posttest motor and sensory outcomes

| Outcome | Pretest M (SD) | Posttest M (SD) | Mean change | 95% CI | t | p | Cohen's dz |
|---|---|---|---|---|---|---|---|
| Motor | 68.13 (4.76) | 82.50 (7.16) | 14.38 | [11.73, 17.02] | 11.01 | < .001 | 1.74 |
| Sensory | 63.13 (4.03) | 81.13 (4.46) | 18.00 | [16.27, 19.73] | 21.06 | < .001 | 3.33 |

Mean change is posttest minus pretest. df = 39 for both paired-samples t tests. SPSS Sig. = .000 is reported as p < .001.

Taken together, both measured outcomes showed higher posttest scores than pretest scores. The sensory outcome had a larger absolute mean increase and a larger standardized within-participant effect size than the motor outcome. These results describe pretest-posttest change in this sample and do not, by themselves, establish that massage was the sole cause of the change.

## 4. Discussion

The principal finding was that motor and sensory scores were significantly higher after the structured massage program than before it. he findings indicate substantial improvements in both motor and sensory outcomes following the complementary massage intervention, with particularly pronounced changes in sensory processing. These results suggest that structured tactile and proprioceptive stimulation may support developmental functioning in preschool-aged children. However, the magnitude of these changes should be interpreted cautiously because the study did not include a control group, and factors such as maturation, classroom activities, repeated testing, and other environmental influences may also have contributed to the observed improvements. Both paired comparisons produced p values below .001, and the standardized changes were large. These findings indicate a strong within-participant pattern across the intervention period. They should nevertheless be interpreted as pretest-posttest associations because the one-group design does not provide a counterfactual comparison.

The motor result is broadly consistent with literature suggesting that repeated developmental stimulation can influence motor performance in young children. A 2024 umbrella review identified motor and psychomotor benefits among several pediatric massage outcomes, although the included evidence varied in quality and was concentrated in younger children (Chen et al., 2024a) (Lu et al., 2019) reported improvements in motor outcomes after repeated massage in young children with developmental delay, while Mahmood et al. (2024) found that pediatric massage used with home exercise contributed to motor-related outcomes in children with spastic cerebral palsy. Indonesian studies have likewise reported motor changes after infant massage (Jannah et al., 2025) (Kristianingrum

et al., 2022) (Rahmadani et al., 2025) The present sample differs because participants were 4-6-year-old kindergarten children rather than infants or children selected for a clinical diagnosis, so direct equivalence should not be assumed.

The motor findings also need to be viewed within the wider preschool movement literature. Structured physical activity, physical literacy programs, and partly structured play can improve motor competence in young children (Chen et al., 2024a) (Telford et al., 2022) (Tortella, 2022) (Wang & Zhou, 2024) (Yang et al., 2025). This literature suggests that development during ages 4-6 is highly responsive to repeated practice and environmental opportunity. Consequently, some motor improvement observed during a 12-week school-based study may reflect not only massage but also maturation, normal classroom movement experiences, outdoor play, and practice effects from repeated assessment. These factors are especially important when interpreting a large Cohen's dz in a study without a control group.

The sensory score also changed substantially. Massage provides direct tactile input and may also provide proprioceptive information through pressure and guided limb movement. This offers a plausible pathway for changes in measured sensory responses. Previous research has reported massage-related changes in sensory sensitivity or tactile abnormalities in clinical populations (Fadlalmola, 2024); (Lu et al., 2019). However, sensory scores require particularly careful interpretation. Standardized sensory measures differ in their dimensions and score direction, and some instruments identify the frequency of sensory behaviors rather than a simple better-to-worse continuum (Gándara-Gafo & Beaudry-Bellefeuille, 2023) (Shahbazi, 2021) For this reason, the exact sensory instrument and scoring manual used in the study must be clearly reported before publication. The numerical increase should only be described as improvement if the instrument's scoring system defines higher scores as more favorable.

From an early childhood education perspective, the findings support the broader principle that development can be strengthened through intentional, repeated, and responsive stimulation. Indonesian evidence emphasizes the role of teachers and parents in sensory stimulation for children aged 4-6 years, while movement-and-song and fine-motor learning models demonstrate the value of varied sensorimotor experiences (Mayar et al., 2022) (Meilanie, 2021); (Wahyuningrum & Watini, 2022) Complementary massage may therefore be considered as one supportive activity within a wider program that includes active play, fine-motor exploration, balance, object manipulation, social interaction, and responsive caregiver involvement. It should not replace these core developmental experiences.

The study also has practical safety implications. The complementary massage sessions were administered by trained research personnel who had received prior instruction in preschool massage techniques, child safety, hygiene, appropriate massage pressure, recognition of discomfort or distress, and procedures for obtaining ongoing child assent. Before data collection, the personnel completed standardized practical training and competency assessment under the supervision of a qualified health professional. (Licciardi & Brown, 2023) (Gándara-Gafo & Beaudry-Bellefeuille, 2023)

The same intervention protocol was followed throughout the 12-week program to maintain consistency across participants., and delivered by trained personnel or caregivers who understand contraindications and child safeguarding. Children should be able to refuse touch or end a session. The intervention should avoid framing compliance as a developmental requirement. Recent pediatric massage reviews have highlighted the need for better adverse-event reporting, making documentation of comfort, refusal, skin reactions, pain, and other unexpected responses important in future research (Chen et al., 2024a)

Several limitations should guide interpretation. First, the one-group pretest-posttest design cannot rule out maturation, testing effects, or other activities occurring during the 12-week period. The target sample size was determined using a convenience-sampling approach based on the number of eligible children available at the study site during the recruitment period. No a priori power calculation was performed. A total of 40 children who met the eligibility criteria and completed all study procedures

were included in the final analysis. Therefore, the sample size should be interpreted in the context of the single-site design and may limit the generalizability and statistical precision of the findings.

Third, the available dataset provides composite motor and sensory scores, but the exact instrument names, score ranges, direction of interpretation, and reliability statistics must be fully documented to support reproducibility. Fourth, the effect sizes were unusually large, particularly for the sensory outcome, which increases the importance of checking data entry, scoring rules, normality of difference scores, and possible ceiling or practice effects. Future studies should use a controlled or randomized design, multiple preschool sites, validated age-appropriate instruments, blinded outcome assessment where feasible, and follow-up measurements to determine whether changes are sustained.

## 5. Conclusion

Children aged 4-6 years at TK Aisyiyah Bustanul Athfal (ABA) Batangtoru showed significantly higher motor and sensory scores after the complementary massage program than at pretest. The motor mean increased from 68.13 to 82.50, with a mean change of 14.38 points, $t(39) = 11.01$, $p < .001$, and Cohen's $dz = 1.74$. The sensory mean increased from 63.13 to 81.13, with a mean change of 18.00 points, $t(39) = 21.06$, $p < .001$, and Cohen's $dz = 3.33$. These results indicate substantial within-participant change during the intervention period and support further investigation of massage as complementary developmental stimulation in preschool settings. The findings should not be interpreted as definitive causal evidence because the study did not include a control group. Motor and sensory development in preschool children can also change through maturation, play, classroom learning, home stimulation, and repeated testing. The exact motor and sensory instruments and their scoring direction must also be stated clearly before journal submission. In practice, massage should remain an adjunct to active play and developmentally appropriate education, be delivered safely, and respect each child's willingness to receive touch. Future research should use stronger controlled designs, multisite samples, validated instruments, and follow-up assessment to clarify the specific contribution and durability of complementary massage effects.

## 6. References

Bolger, L. E., Bolger, L. A., O'Neill, C., Coughlan, E., O'Brien, W., Lacey, S., Burns, C., & Bardid, F. (2021). Global levels of fundamental motor skills in children: A systematic review. *Journal of Sports Sciences*, 39(7), 717-753. https://doi.org/10.1080/02640414.2020.1841405

Chen, D., Zhao, G., Fu, J., Shun, S., Su, L., He, Z., Chen, R., Jiang, T., Hu, X., Li, Y., & Shen, F. (2024a). Effects of structured and unstructured interventions on fundamental motor skills in preschool children: A meta-analysis. *Frontiers in Public Health*, 12, Article 1345566. https://doi.org/10.3389/fpubh.2024.1345566

Chen, S.-C., Lin, S.-L., Wang, M., Cheung, D. S.-T., Liang, J.-G., Cheng, Z.-Y., Yuen, C. S., & Yeung, W.-F. (2024b). Pediatric massage therapy in infants and children under 5 years: An umbrella review of systematic reviews. *Heliyon*, 10(16), Article e35993. https://doi.org/10.1016/j.heliyon.2024.e35993

Creswell, J. W. (2017). Research design: Qualitative, quantitative, and mixed methods approaches (4th ed.). *Sage Publications.*

Fadlalmola, H. A. (2024). Effects of massage on self-regulatory difficulties, tactile and oral abnormalities, and parenting stress in children with autism spectrum disorder: A systematic review and meta-analysis. *International Journal of Therapeutic Massage & Bodywork*, 17(4), 4-19. https://doi.org/10.3822/ijtmb.v17i4.1079

Flores, P., Coelho, E., Mourão-Carvalhal, M. I., & Forte, P. (2023). Association between motor and math skills in preschool children with typical development: Systematic review. *Frontiers in Psychology*, 14, Article 1105391. https://doi.org/10.3389/fpsyg.2023.1105391

Gándara-Gafo, B., & Beaudry-Bellefeuille, I. (2023). Convergent validity of two sensory questionnaires in Spain: *Sensory Profile-2 and Sensory Processing Measure. Children*, 10(9), 1516. https://doi.org/10.3390/children10091516

Jannah, M., Nawangsari, D., & Akaputri, D. E. (2025). Efektivitas Pijat Bayi Terhadap Peningkatan Motorik Pada Bayi Usia 6-12 Bulan di Klinik "A" Bogor. *Jurnal Bidang Ilmu Kesehatan*, 15(2), 177-182. https://doi.org/10.52643/jbik.v15i2.6296

Jeong, J., Franchett, E. E., Ramos de Oliveira, C. V., Rehmani, K., & Yousafzai, A. K. (2021). Parenting interventions to promote early child development in the first three years of life: A global systematic review and meta-analysis. *PLoS Medicine*, 18(5), Article e1003602. https://doi.org/10.1371/journal.pmed.1003602

Jones, D., Innerd, A., Giles, E. L., & Azevedo, L. B. (2020). Association between fundamental motor skills and physical activity in the early years: A systematic review and meta-analysis. *Journal of Sport and Health Science*, 9(6), 542-552. https://doi.org/10.1016/j.jshs.2020.03.001

Jones, S., Yu, M.-L., & Brown, T. (2024). Convergent validity between the school-age versions of the Sensory Processing Measure 2 (SPM2) and the Sensory Profile 2 (SP2): A pilot study. *Australian Occupational Therapy Journal*, 71(5), 718-732. https://doi.org/10.1111/1440-1630.12958

KEMENKES. (2025). Rahasia anak sehat dan cerdas, lakukan stimulasi tumbuh kembang! Dengan Buku KIA. *Kementerian Kesehatan Republik Indonesia.* https://ayosehat.kemkes.go.id/rahasia-anak-sehat-dan-cerdas-lakukan-stimulasi-tumbuh-kembang-dengan-buku-kia

Kristianingrum, D. Y., Setiarini, D. A. K., Fatoni, I., & Aini, I. (2022). Pengaruh Pijat Bayi Terhadap Peningkatan Motorik Kasar Pada Bayi. *Jurnal Abdi Medika*, 2(1), 24-28.

Licciardi, L., & Brown, T. (2023). An overview & critical review of the Sensory Profile–second edition. *Scandinavian Journal of Occupational Therapy*, 30(6), 758-770. https://doi.org/10.1080/11038128.2021.1930148

Lu, W. P., Tsai, W. H., Lin, L. Y., Hong, R. B., & Hwang, Y. S. (2019). The beneficial effects of massage on motor development and sensory processing in young children with developmental delay: A randomized control trial study. *Developmental Neurorehabilitation*, 22(7), 487-495. https://doi.org/10.1080/17518423.2018.1537317

Mahmood, Q. H., Habibullah, S., & Aurakzai, H. U. (2024). Effectiveness of simple and basic home-based exercise programs including pediatric massage executed by caregivers at their homes in the management of children with spastic cerebral palsy: A randomized controlled trial. *Journal of Pediatric Rehabilitation Medicine*, 17(1), 97-106. https://doi.org/10.3233/PRM-220135

Mayar, F. S., Sakti, R., Yanti, L., Erlina, B., Osriyenti, O., & Holiza, W. (2022). Pengaruh video pembelajaran gerak dan lagu untuk meningkatkan fisik motorik pada anak usia dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(4), 2619-2625. https://doi.org/10.31004/obsesi.v6i4.2081

Meilanie, R. S. (2021). Survei kemampuan guru dan orangtua dalam stimulasi dini sensori pada anak usia dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 5(1), 958-964. https://doi.org/10.31004/obsesi.v5i1.741

Rahmadani, F. N., Ananditha, K., Adinda, L. D., & Situmorang, T. S. R. (2025). Pengaruh Pijat Bayi Terhadap Perkembangan Motorik Anak Usia 0-2 Tahun: Literatur Review. *NERSMID: Jurnal Keperawatan dan Kebidanan*, 8(1), 8-19. https://doi.org/10.55173/nersmid.v8i1.235

Safitri, Y. A., Amran, H. F., Ningsih, R. A., Kirana, D. N., Zulfa, S. Z., Dale, D. S., & Ariyani, D. (2024). Penyuluhan kesehatan dan pemantauan perkembangan anak usia dini dengan pemanfaatan kuesioner pra skrining perkembangan di laboratorium Institut Kesehatan. *Smart Dedication: Jurnal Pengabdian Masyarakat*, 1(2), 119-127. https://doi.org/10.70427/smartdedication.v1i2.52

Shahbazi, M. (2021). Assessment of sensory processing characteristics in children between 0 and 14 years of age: A systematic review. *Iranian Journal of Child Neurology*, 15(1), 29-46. https://doi.org/10.22037/ijcn.v15i1.21274

Simangunsong, S. W., Machfudz, S., & Sitaresmi, M. N. (2012). Accuracy of the Indonesian child development pre-screening questionnaire. *Paediatrica Indonesiana*, 52(1), 6-9. https://doi.org/10.14238/pi52.1.2012.6-9

Stevenson, A., Wainwright, N., & Williams, A. (2023). Interventions targeting motor skills in pre-school-aged children with direct or indirect parent engagement: A systematic review and narrative synthesis. *Education 3-13*, 51(6), 1003-1016. https://doi.org/10.1080/03004279.2022.2034174

Telford, R. M., Olive, L. S., & Telford, R. D. (2022). The effect of a 6-month physical literacy intervention on preschool children's gross and fine motor skill: The Active Early Learning randomised controlled trial. *Journal of Science and Medicine in Sport*, 25(8), 655-660. https://doi.org/10.1016/j.jsams.2022.04.009

Tortella, P. H. (2022). Effects of free play and partly structured playground activity on motor competence in preschool children: A pragmatic comparison trial. *International Journal of Environmental Research and Public Health*, 19(13), Article 7652. https://doi.org/10.3390/ijerph19137652

Wahyuningrum, M. D., & Watini, S. (2022). Inovasi Model ATIK dalam meningkatkan motorik halus pada anak usia dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(5), 5384-5396. https://doi.org/10.31004/obsesi.v6i5.3038

Wang, X., & Zhou, B. (2024). Motor development-focused exercise training enhances gross motor skills more effectively than ordinary physical activity in healthy preschool children: An updated meta-analysis. *Frontiers in Public Health*, 12, Article 1414152. https://doi.org/10.3389/fpubh.2024.1414152

World Health Organization [WHO]. (2018). Nurturing care for early childhood development: *A framework for helping children survive and thrive to transform health and human potential.* https://www.who.int/publications/i/item/9789241514064

Yang, Y., Mao, X., Li, W., Wang, B., & Fan, L. (2025). A meta-analysis of the effect of physical activity programs on fundamental movement skills in 3-7-year-old children. *Frontiers in Public Health*, 12, Article 1489141. https://doi.org/10.3389/fpubh.2024.1489141