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The Effect Of Cup Stacking Games On Hand Dexterity (Fine Motor Skills) Sharefit Surabaya

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Abstract

The purpose of this research was to analyze the influence of cup stacking games on participants' fine motor skills, specifically to (1) measure changes in hand speed and hand–eye coordination, (2) evaluate the effectiveness of cup stacking as a fine motor stimulator, and (3) provide practical recommendations for implementing this activity in educational or recreational fitness settings. The study employed an experimental design using a pretest–posttest control group method. A total of 20 participants aged 6–10 years were purposively selected and equally divided into control and experimental groups. Both groups completed a standardized fine motor test before and after the intervention. The experimental group received cup stacking training for three weeks (three sessions per week, 40 minutes each), consisting of progressive coordination and reflex exercises. Data were analyzed using parametric statistical tests after normality and homogeneity assumptions were confirmed. The Paired Samples t-Test showed a significant difference between pretest and posttest scores ($t = -5.891$, $p < 0.001$), indicating that cup stacking effectively improved participants' fine motor abilities. However, the Independent Samples t-Test revealed no significant difference between the control and experimental groups ($p = 0.137$), suggesting that both groups improved, but not to a statistically distinct degree. These findings confirm that cup stacking has a positive and measurable influence on fine motor enhancement through repeated, coordinated, and visually guided hand movements. The activity stimulates motor learning processes, supports neuromuscular adaptation, and can be implemented as a low-cost and engaging training method in educational or recreational environments. In conclusion, cup stacking represents an innovative and enjoyable approach for fine motor development, encouraging further research with larger samples, longer interventions, and advanced assessments such as biomechanical or neurophysiological analyses to explore its broader impact on motor performance.

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INTRODUCTION

The development of fine motor skills, which includes small hand muscle manipulation and hand-eye coordination, is a fundamental aspect of daily activities such as writing, assembling, and other precision tasks. Stimulating these skills is important from an early age and in the context of adult physical training to support efficiency, accuracy, and responsiveness to fine motor tasks (Narang & Gharote, 2025). In the digital age, increased exposure to electronic devices has led to a more sedentary lifestyle, which can potentially hinder fine motor skill development. Therefore, enjoyable and effective physical activities are needed as an alternative form of stimulation, one of which is cup stacking, which requires concentration, speed, and coordination (Christian et al., 2024). According to Wang and Wang (2024) found through a systematic review that both fine and gross motor skills are positively correlated with students' academic achievements, particularly in language and mathematics subjects, suggesting that physical-motor development supports cognitive learning processes. In line with this, Ghanamah, (2025) notes that the decline in physical activity among children due to digital engagement highlights the importance of incorporating enjoyable and structured motor activities, such as stacking cups, to enhance coordination and cognitive growth.

Fine motor skills constitute essential abilities for executing precise movements involving small muscle groups, enabling tasks that require accuracy and bilateral coordination. Winter et al. (2021) found that improvements in fine motor coordination directly relate to enhanced lexical processing and cognitive efficiency in both children and adults, indicating strong integration between motor and linguistic systems. Coordination-based training has consistently been shown to enhance children's physical fitness, motor competence, and inhibitory control (Başarır et al., 2025). This connection between motor and cognitive domains aligns with evidence that fine motor abilities are closely linked to lexical processing and memory development (Winter et al., 2021). Moreover, reviews of motor skill interventions highlight that consistent, play-based motor practice produces measurable improvements in both psychomotor and attentional domains (Shi et al., 2022).

Normatively, sports education in Indonesia is regulated by Law Number 3 of 2005 concerning the National Sports System (Article 25), which emphasizes the importance of developing sports in education. In addition, Law No. 11 of 2022 on Sports affirms the government's obligation to develop sports education and society as part of the transformation of the national sports culture (Gilang & Ma, 2022).

The legal basis provided by Law No. 3 of 2005 and Law No. 11 of 2022 provides regulatory space for the integration of innovative programs such as cup stacking educational games into physical education. However, research shows that although policies have supported educational sports, their implementation in the field is still uneven and lacks innovation (Mahendra et al. 2020).

During my initial observation at ShareFit Surabaya, I noticed several children who had difficulty following the coach's instructions and played on their own without following the instructions or games that were given. After approaching them, I found out that they were bored and had difficulty with the games. This

situation reflects a tendency among children to want fun and exciting games that stimulate their curiosity. In light of this issue, this study was designed to improve fine motor skills through fun games using cup stacking to enhance hand dexterity (fine motor skills) at ShareFit Surabaya. This activity is expected to be a sustainable solution for improving children's growth and development through fine motor skills using cup stacking games.

Empirical studies reinforce that structured and playful motor tasks contribute significantly to skill acquisition. Interventions emphasizing bilateral coordination, hand precision, and reaction speed yield measurable gains in children's functional performance (Haas et al., 2022). For instance, short-term coordination-based programs have been shown to promote positive changes in balance, timing, and task accuracy, even within preschool settings (Stuhr, 2025). These findings support the educational integration of play-oriented activities that bridge motor learning and cognitive engagement, establishing a foundation for active, lifelong participation in physical movement.

Several studies relevant to the research topic. A recent study by (Binks et al. 2023) emphasizes that cup stacking skills can develop significantly even without direct physical practice, but rather through a combination of action observation and motor imagery (AO+MI). The results of this study, which used a Graeco–Latin Square design, show that participants who practiced with the AO+MI method were able to complete the cup stacking task with faster execution times compared to the observation-only, imagery-only, and control groups. These findings reinforce the view that cup stacking is an effective activity for improving fine motor coordination, particularly in terms of speed and hand manipulative skills.

Matthew et al. (2023) also conducted research related to the application of parent-guided home-based interventions using a combination of AO+MI in children with Developmental Coordination Disorder (DCD). One of the activities used in the study was the 363 cup stacking formation, which requires hand-eye coordination and finger manipulation skills. The results showed an improvement in coordination skills and manual task execution in children who participated in the intervention. This study provides empirical evidence that cup stacking is not only beneficial for recreational purposes, but can also be used as a means of therapy and fine motor learning in various age groups.

Therefore, (Yu et al. 2024) Researching the sport stacking program in a population with mild cognitive impairment (MCI) found that this activity can improve cognitive function and hand coordination skills. Although the main focus of the study was cognitive aspects, the findings regarding improved motor coordination and hand function provide an important basis for the effectiveness of cup stacking in training manual dexterity. The mechanisms emphasized in the study were improvements in manipulation speed, bilateral coordination, and active participant involvement. This shows that cup stacking has great potential for application in the context of fine motor training, both for therapeutic purposes and for skill improvement at fitness centers such as Sharefit Surabaya.

Cup stacking also known as sport stacking represents a unique training modality combining rapid hand movements, bilateral coordination, and sequential planning. Experimental studies reveal that both physical and mental practice of cup stacking significantly improve speed and fine motor control (Binks et al., 2023; Hansen, 2022). Beyond skill performance, neurophysiological

evidence indicates that stacking tasks stimulate neural pathways related to motor planning and attention regulation (Yang et al., 2022). Despite these benefits, many physical education programs still emphasize gross motor activities, leaving limited attention to fine motor-focused interventions. Therefore, the present research seeks to evaluate cup stacking as an accessible, engaging, and effective model for enhancing hand dexterity and coordination among children.

In the realm of children's fine motor development, interventions using creative media have also proven effective. For example, Dry Leaf Collage in early childhood has been shown to significantly improve fine motor skills by stimulating hand-eye coordination and manipulative skills. Similarly, Magic Sand play activities show significant progress in hand-finger coordination in children aged 4–5 years (Made et al. 2024).

Although there are a number of studies that confirm the effectiveness of fine motor stimulation through the use of creative media, studies that specifically highlight the effects of cup stacking games in the context of fitness centers, such as Sharefit Surabaya, are still very limited. Most existing studies focus more on early childhood with an educational approach, so its application in non-school settings and in adolescent and young adult groups has not been widely explored. This situation indicates a gap between the theoretical applications developed in academic literature and practical applications in the field. Thus, research on cup stacking in fitness centers is important, not only as a form of innovation in physical training methods, but also to provide empirical contributions to the development of more creative, adaptive, and scientifically-based fitness programs.

Based on this background and gap, this study aims to investigate the effect of cup stacking on the manual dexterity (fine motor skills) of Sharefit Surabaya participants. Specific objectives include: (a) measuring changes in hand speed and hand-eye coordination; (b) evaluating the effectiveness of the new method (cup stacking) as a fine motor stimulator; and (c) providing theoretical and practical recommendations for application in the framework of sports coaching based on national policy.

METHODS

This study was conducted using a quantitative experimental approach to examine the effect of cup stacking games on hand dexterity (fine motor skills) in children. A pre-test and post-test control group design was employed to compare changes in fine motor performance between participants who received the intervention and those who did not. The methodological procedures were systematically structured to ensure the reliability and validity of the data collected, including participant selection, implementation of the intervention, and data analysis techniques.

Participants

The participants in this study were 20 children who were active members of ShareFit Surabaya, aged between 6 and 10 years. All participants met the inclusion criteria, namely being physically healthy, having no history of motor development disorders, and regularly participating in ShareFit activities. The participants were evenly divided into two groups: a control group consisting of 10 children (C1) and an experimental group consisting of 10 children (E2).

Sampling Procedures

The sampling technique used in this study was purposive sampling. Participants were selected based on predetermined inclusion criteria to ensure that all children had similar physical

conditions and developmental backgrounds. This technique was chosen to obtain participants who were suitable for the intervention and to minimize confounding variables related to health and motor development.

Materials and Apparatus

The research instrument used to measure fine motor skills was a cup stacking game test administered during the pre-test and post-test phases. This instrument was selected due to its validity in assessing hand coordination, speed, and fine motor accuracy. The measurement was conducted by recording the time required for participants to arrange and tidy up cups according to a specified pattern. The apparatus used in this study included Speed Stacks® stacking cups, a digital stopwatch, tennis balls, and standard-sized plastic balls suitable for children.

Procedures

This study employed an experimental approach with a pre-test and post-test control group design. Both groups participated in the pre-test using the cup stacking game to assess baseline fine motor skills. The control group only participated in the pre-test and post-test without receiving any additional treatment.

The experimental group received a motor skills training program conducted over nine sessions, three times per week for three weeks. Each session lasted 40 minutes and consisted of a warm-up, core training activities, and a cool-down phase. During the first week, participants performed paired ball throwing and catching activities to improve hand eye brain coordination. In the second week, the training focused on throwing and catching a tennis ball against a wall using the right hand to throw and the left hand to catch, aiming to enhance reflexes and hand dexterity. In the third week, participants engaged in juggling activities designed to improve concentration and hand coordination. After completing all training sessions, both groups underwent a post-test using the same cup stacking test.

Design or Data Analysis

The research design used was a pre-test and post-test control group experimental design. Data obtained from the cup stacking test were analyzed by comparing pre-test and post-test results between the control and experimental groups. The analysis focused on changes in completion time as an indicator of improvements in hand dexterity and fine motor skills resulting from the cup stacking game intervention.

RESULT

This study aimed to determine the effect of cup stacking games on hand dexterity (fine motor skills) among ShareFit Surabaya participants. The experiment involved 20 participants divided equally into two groups: **control** (1) and **experimental** (2). Both groups completed pretest and posttest sessions to measure their fine motor skills.

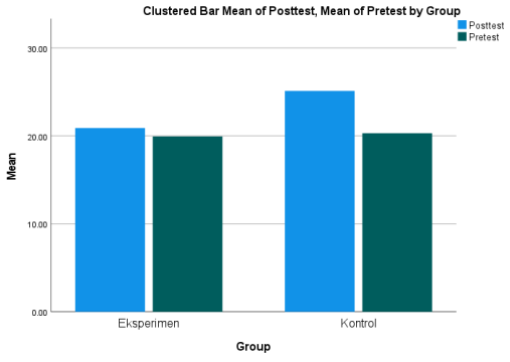

Fig 1. Graphic

Table 2. Descriptive Statistics of Pretest and Posttest Scores for Experimental and Control Groups

Group	N	Mean Pretest	SD Pretest	Mean Posttest	SD Posttest
Experimental	10	19.95	4.26	20.90	4.28
Control	10	20.31	7.51	25.12	7.44
Total	**20**	**20.13**	**5.94**	**23.01**	**6.29**

The results in Table 2 show that both groups had similar mean pretest scores, indicating that participants' initial fine motor abilities were relatively comparable before treatment. After the intervention, the control group demonstrated a marked increase in the posttest mean (from 20.31 to 25.12), while the experimental group showed a slight improvement (from 19.95 to 20.90). These results suggest that, descriptively, the control group experienced higher numerical gains in posttest scores. However, this descriptive difference does not automatically indicate a significant effect, so further inferential tests (t-tests) are necessary to confirm whether the difference is statistically meaningful. Table 2 presents the results of the normality test using the Kolmogorov–Smirnov and Shapiro–Wilk tests for both groups (experimental and control) at the pretest and posttest stages.

Table 3. Test of Normality for Pretest and Posttest Scores in Experimental and Control Groups

Variable	Group	Kolmogorov–Smirnov Sig.	Shapiro–Wilk Sig.	Interpretation
Pretest	Experimental	0.141	0.373	Normal
Pretest	Control	0.200	0.149	Normal
Posttest	Experimental	0.170	0.464	Normal
Posttest	Control	0.200	0.550	Normal

Based on Table 3, all variables in both the experimental and control groups at the pretest and posttest stages have significance (Sig.) values greater than 0.05 on both the Kolmogorov–Smirnov and Shapiro–Wilk tests. This indicates that all data are normally distributed, fulfilling one of the key assumptions required to conduct parametric statistical tests such as the *Paired Samples t-Test* and *Independent Samples t-Test*. In other words, the distribution of pretest and posttest scores in both groups does not deviate significantly from normality, which supports the validity of subsequent inferential analyses.

To determine whether there was an effect of the cup stacking activity on participants' fine motor skills, a paired samples t-test was conducted by comparing pretest and posttest scores.

Table 4. Paired Samples t-Test of Pretest and Posttest Scores

Pair	Mean Difference	Std. Deviation	t	df	Sig. (2-tailed)	Interpretation
Pretest – Posttest	-2.881	2.187	-5.891	19	< 0.001	Significant

Based on the results of the *Paired Samples t-Test* on table 4, a t-value of -5.891 with a Sig. (2-tailed) < 0.001 indicates a significant difference between pretest and posttest scores. The higher posttest mean demonstrates that participants' fine motor skills (hand dexterity) improved after the cup stacking intervention. This activity effectively enhances hand–eye coordination and manipulative ability through repetitive, rapid, and coordinated hand movements, strengthening finger control and precision. Therefore, it can be concluded that the cup stacking game has a positive and significant effect on improving participants' fine motor skills at ShareFit Surabaya.

Table 5 shows the results of the *Independent Samples t-Test* comparing the mean scores of the control (K1) and experimental (K2) groups at both the pretest and posttest stages.

Table 5. Independent Samples t-Test of Pretest and Posttest Scores between Experimental and Control Groups

Variable	Levene's Test Sig.	t	df	Sig. (2-tailed)	Mean Difference	Interpretation
Pretest	0.053	-0.131	18	0.897	-0.36	No significant difference
Posttest	0.085	-1.556	18	0.137	-4.22	No significant difference

Based on Table 5, the Levene's Test for Equality of Variances for both pretest and posttest shows significance values greater than 0.05 ($p = 0.053$ and $p = 0.085$). This indicates that the data for both variables meet the homogeneity assumption the variance between the two groups can be considered equal. For the pretest, the significance value (Sig. 2-tailed) is 0.897 (> 0.05), indicating that there was no significant difference between the control and experimental groups before treatment. This confirms that both groups had comparable fine motor abilities prior to the intervention. For the posttest, the significance value is 0.137 (> 0.05), which also indicates no significant difference between the groups after treatment. Although the experimental group showed higher mean scores descriptively, the difference was not statistically significant, suggesting that the improvement in fine motor skills after cup stacking treatment was not strong enough to differ from the control group at the 0.05 significance level.

DISCUSSION

The *Paired Samples t-Test* result ($t = -5.891$, $p < 0.001$) revealed a significant increase in posttest scores compared to pretest scores, confirming that the *cup stacking* intervention effectively improved participants' fine motor skills. This finding supports the main hypothesis and highlights that structured, repetitive, and time-pressured hand movements can promote neuromotor adaptation. Such activities demand precise coordination between visual and motor systems, thereby strengthening hand–eye synchronization and overall dexterity. The improvement observed suggests that even a relatively short intervention period can yield measurable gains in hand coordination and fine motor performance when training is focused and systematic.

Winstein et al. (2016) emphasized that repetitive, task-oriented movements play a critical role in restoring and optimizing motor control through neuroplastic adaptation. Such mechanisms support the argument that structured, bilateral hand activities can serve as effective models for improving coordination and dexterity in non-clinical settings, especially among youth populations.

However, the comparative hypothesis predicting a significantly greater improvement in the experimental group compared to the control group was not fully supported (independent t-test, $p = 0.137$). Although both groups demonstrated progress from pretest to posttest, the difference between them was not statistically significant. This outcome may be attributed to several methodological factors, including the limited sample size, relatively short intervention duration, and possible engagement in manual or motor-related activities outside the training sessions. These uncontrolled variables could have minimized group contrasts, implying that while *cup stacking* improved motor ability overall, the magnitude of difference between groups requires further exploration in studies with larger and more controlled samples.

The observed improvements in fine motor dexterity are consistent with neurocognitive mechanisms described in prior literature. Structured and repetitive bilateral movements in cup stacking are known to enhance cortico-motor connectivity and timing precision (Yang et al., 2022). This supports evidence that manual dexterity exercises improve not only manipulation speed but also working memory and inhibitory control (Stuhr, 2025; Chichinina et al., 2025). Previous coordination interventions have similarly reported that participants with higher baseline motor quotient exhibit greater

responsiveness to training (Ge et al., 2025). Together, these findings affirm that fine motor training integrates perceptual, motor, and cognitive processes that evolve through repetition and feedback.

These findings align with contemporary literature on sport stacking and motor learning. Recent randomized controlled trials (RCTs) and experimental studies have demonstrated that structured sport stacking or combined *Action Observation* and *Motor Imagery (AO+MI)* training can enhance both motor and cognitive functions when performed regularly found that a 12-week sport stacking program improved neuropsychological and neurobiological indicators in patients with mild cognitive impairment, suggesting a neural adaptation mechanism that parallels improvements in fine motor control observed in the present study (Yang et al, 2022).

Complementary to global evidence, local research from Indonesian scholars emphasizes methodological rigor in assessing physical performance and motor skills. Rusdiawan et al. (2024) examined the relationship between physical capacity and athletic performance among sub-elite Indonesian athletes, highlighting the importance of valid measurement tools and controlled training conditions. Similarly, Susanto, Wiriadinata, and Rusdiawan (2022) developed a standardized talent identification instrument for early-age basketball players, underscoring the relevance of precise assessment tools in motor development studies. These local contributions support the methodological implications of the present findings: longer intervention duration, larger sample sizes, and controlled experimental conditions are essential to capture between-group effects more accurately.

Comparable findings in coordination-based and sport-stacking interventions emphasize the importance of consistent practice duration. Short-term programs can produce retention gains, but long-term engagement amplifies both accuracy and automaticity (Hansen, 2022). Binks et al. (2023) further confirmed that optimized distribution of practice enhances reaction time and bilateral synchronization. The present study's findings thus align with systematic reviews showing that structured physical activity programs significantly elevate children's motor competence (Shi et al., 2022; Moon et al., 2024). These outcomes underline the pedagogical value of cup stacking as a low-cost, enjoyable, and evidence-based approach to developing fine motor coordination in educational settings.

In conclusion, the present findings confirm that cup stacking training effectively enhances hand dexterity and coordination among children, consistent with previous evidence on coordination-based learning (Başarır et al., 2025; Binks et al., 2023). Integrating fine motor tasks such as sport stacking into school-based or community programs can provide both physical and cognitive benefits. Given its playful and engaging nature, cup stacking serves not only as a motor exercise but also as a tool for fostering focus, self-regulation, and confidence. Future research should explore variations in duration, feedback mechanisms, and group collaboration to further maximize fine motor learning outcomes in diverse populations.

this study demonstrates that *cup stacking* can significantly improve fine motor performance within participants, supporting the primary hypothesis. Although the between-group difference was not statistically significant, the trend favored the experimental group. Practically, *cup stacking* shows promise as an engaging and low-cost training activity to enhance hand dexterity and coordination. Future studies are recommended to include larger participant

samples, extend intervention duration, and incorporate additional outcome measures such as speed, accuracy, and neurophysiological parameters to better understand the mechanisms underlying fine motor skill improvement.

CONCLUSION

This study demonstrated that the *cup stacking* intervention significantly improved participants' fine motor skills, as indicated by the higher posttest scores compared to pretest results. The findings support the main hypothesis that structured, repetitive, and time-based coordination activities can effectively enhance hand dexterity and visual–motor integration, even within a relatively short training period. The nature of *cup stacking* which requires precision, rhythm, and bilateral coordination appears to stimulate neuromuscular adaptation and improve motor control efficiency.

Although no statistically significant difference was found between the experimental and control groups, the general improvement across participants suggests that *cup stacking* provides meaningful benefits for motor skill development. These results highlight the potential of *cup stacking* as an accessible and enjoyable training medium that combines physical coordination with cognitive engagement. Future research is encouraged to employ larger and more diverse samples, extend intervention duration, and integrate advanced assessments such as biomechanical tracking, reaction time analysis, or neurophysiological measures to gain deeper insight into the mechanisms underlying fine motor improvement through *cup stacking* activities.

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REFERENCES

Başarır, B., Canlı, U., Şendil, A. M., Alexe, C. I., Tomozei, R. A., Alexe, D. I., & Burchel, L. O. (2025). Effects of coordination-based training on preschool children's physical fitness, motor competence and inhibition control. *BMC Pediatrics*, *25*(1). https://doi.org/10.1186/s12887-025-05897-x

Binks, J. A., Wilson, C. J., Van Schaik, P., & Eaves, D. L. (2023). Motor learning without physical practice: The effects of combined action observation and motor imagery practice on cup-stacking speed. *Psychology of Sport and Exercise*, *68*, 102468. https://doi.org/10.1016/j.psychsport.2023.102468

Chichinina, E., Gavrilova, M., & Drid, P. (2025). Executive function skills predict motor competence in preschool children. *BMC Pediatrics*, *25*(1). https://doi.org/10.1186/s12887-025-05582-z

Christian, H. E., Adams, E. K., Moore, H. L., Nathan, A., Murray, K., Schipperijn, J., & Trost, S. G. (2024). Developmental trends in young children ' s device-measured physical activity and sedentary behaviour. 1–13.

Ge, S., Liu, H., Song, C., Zhang, W., & Guo, X. (2025). Evaluating the impact of motor quotient physical fitness training on health-related fitness indicators and obesity risk in children aged 7–8 years in Tianjin, China. *BMC Public Health*, *25*(1). https://doi.org/10.1186/s12889-

025-21985-0

Ghanamah, R. (2025). The Impact of Physical Activity and Screen Time on Motor Creativity in Kindergarteners. 1–13.

Gilang, M., & Ma, A. (2022). Journal Sports Area Analysis of community sports development based on the sports law for development through sports. 7(3), 380–395.

Haas, P., Sudeck, G., Kelava, A., Cattarius, M., Meibohm, M., Schmid, J., Kistoglidou, E., & Gawrilow, C. (2022). Acute effects of a motor coordination intervention on executive functions in kindergartners: a proof-of-concept randomized controlled trial. *Pilot and Feasibility Studies*, *8*(1). https://doi.org/10.1186/s40814-022-01125-w

Hansen, M. B. L., Petersen, K., Østergaard, S. B., Nielsen, T. K., Jensen, N. G. K., Mrachacz-Kersting, N., & Oliveira, A. S. (2022). Retention following a short-term cup stacking training: Performance and electrocortical activity. *Science & Sports*, *37*(8), 800.e1–800.e9. https://doi.org/10.1016/j.scispo.2021.12.002

Made, Ni, Ayu Setiari, Wayan Suyanta, Wayan I. Gede Suryawan, and Nurul Hikmah. 2024. "Developing Fine Motor Skills in Children Through Dry Leaf Collage Activities." 1.

Matthew, W., David J. Combined, Matthew W. Scott Id, Greg Wood Id, Paul S. Holmes, Ben Marshall, Jacqueline Williams, and David J. Wright Id. 2023. "This Is the Published Version of the Following Publication Combined Action Observation and Motor Imagery Improves Learning of Activities of Daily Living in Children with Developmental Coordination Disorder." doi: 10.1371/journal.pone.0284086.

Moon, J., Webster, C. A., Stodden, D. F., Brian, A., Mulvey, K. L., Beets, M., Egan, C. A., McIntosh, L. I. F., Merica, C. B., & Russ, L. (2024). Systematic review and meta-analysis of physical activity interventions to increase elementary children's motor competence: a comprehensive school physical activity program perspective. *BMC Public Health*, *24*(1). https://doi.org/10.1186/s12889-024-18145-1

Narang, H. K., & Gharote, G. (2025). The Effect of Sports Stacking Speed on Handwriting Speed in School Going Children : Randomized Control Trial. 7(6), 1–10.

Ramadhan, Muhammad Gilang, Amung Ma, and Agus Mahendra. 2020. " Implementation of Educational Sports Policy as a Development Effort Through Sports Based on the National Sports System Law." 5. doi: 10.17509/jtikor.v5i1.23824.

Rhea, C., Ludwig, K., & Butcher-Mokha, M. (2006). The science of cup stacking: a review of how prior research "stacks up" Title: The Science of Cup Stacking: A Review of How Prior Research "Stacks Up."

Rusdiawan, A., Kusuma, D. A., & Jiménez, J. V. G. (2024). Physical capacity and performance correlation in sub-elite Indonesian archery athletes. Retos, 54, 441–482.

Shi, P., & Feng, X. (2022). Motor skills

and cognitive benefits in children and adolescents: Relationship, mechanism and perspectives. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.1017825

Stuhr, C., Hughes, C. M. L., & Stöckel, T. (2025). Effectiveness of a manual dexterity training program to improve executive functioning in preschool children: an individual difference analysis. *Frontiers in Cognition*, *4*. https://doi.org/10.3389/fcogn.2025.1433759

Susanto, N., Wiriadinata, W., & Rusdiawan, A. (2022). Development of a Talent Identification Test Instrument for Early-Age Basketball Players. JOSSAE (Journal of Sport Science and Education).

Wang, L., & Wang, L. (2024). Relationships between Motor Skills and Academic Achievement in School-Aged Children and Adolescents: A Systematic Review. *Children*, *11*(3), 336. https://doi.org/10.3390/children11030336

Winstein, C. J., Stein, J., Arena, R., Bates, B., Cherney, L. R., Cramer, S. C., Deruyter, F., Eng, J. J., Fisher, B., Harvey, R. L., Lang, C. E., MacKay-Lyons, M., Ottenbacher, K. J., Pugh, S., Reeves, M. J., Richards, L. G., Stiers, W., & Zorowitz, R. D. (2016). Guidelines for adult stroke rehabilitation and recovery. *Stroke*, *47*, 6. https://doi.org/10.1161/STR.0000000000000098

Winter, R. E., Stoeger, H., & Suggate, S. P. (2021). Fine Motor Skills and Lexical Processing in Children and Adults. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.666200

Yang, Z., Zhang, W., Liu, D., Zhang, S., Tang, Y., Song, J., Long, J., Yang, J., Jiang, H., Li, Y., Liu, X., Lü, Y., & Ding, F. (2022). Effects of Sport Stacking on Neuropsychological, Neurobiological, and Brain Function Performances in Patients With Mild Alzheimer's Disease and Mild Cognitive Impairment: A Randomized Controlled Trial. *Frontiers in Aging Neuroscience*, *14*. https://doi.org/10.3389/fnagi.2022.910261

Yang, Ziying, Jun Yang, and Doris S. F. Yu. 2024. "Effects of Sport Stacking on Cognition in Patients With Mild Alzheimer ' s Disease and MCI : Preliminary Findings of Randomized Controlled Trial." 37(1):24–38. doi: 10.1177/08919887231195227.

Zhang, B.-F., Lin, Z.-C., & Li, C. (2025). Fine motor skills assessment instruments for preschool children with typical development: a scoping review. *Frontiers in Psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1620235