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CHANGES IN SPEED AND HAND–EYE COORDINATION FOLLOWING A 12-WEEK GAME-BASED MINI-HANDBALL PROGRAM IN GIRLS AGED 8 TO 10 YEARS

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Abstract: This study examined changes in short-distance speed and hand–eye coordination after a 12-week game-based mini-handball program in novice girls. Fourteen players aged 8–10 years from one club completed two 80-min training sessions per week. Ten dynamic games and their progressions were integrated into each session for 15–25 min and targeted sprinting, ball handling, passing, catching, shooting and dribbling. Before and after the program, participants completed two 10-trial coordination tasks (aiming accuracy; throw–catch coordination), a 10 m sprint and a 10 m dribble sprint. Paired-samples tests, 95% confidence intervals (CI), Wilcoxon sensitivity analyses and paired effect sizes (Cohen d_z) were calculated. Aiming accuracy increased from 5.86 ± 1.75 to 7.79 ± 1.42 successful trials (mean change 1.93, 95% CI 1.20–2.66; $p < 0.001$; $d_z = 1.52$). Throw–catch coordination increased from 2.86 ± 1.17 to 6.43 ± 1.40 trials (change 3.57, 95% CI 2.94–4.20; $p < 0.001$; $d_z = 3.28$). Sprint time decreased by 0.24 s (95% CI 0.18–0.30; $p < 0.001$; $d_z = 2.26$) and dribble-sprint time decreased by 0.22 s (95% CI 0.15–0.28; $p < 0.001$; $d_z = 1.94$). The findings indicate substantial pre–post improvement, particularly in the task most closely aligned with repeated throwing and catching practice. Because the study lacked a control group, the changes should not be attributed exclusively to the dynamic games.

Key words: coordination, dynamic games, mini-handball, motor learning, sprint performance, youth sport.

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INTRODUCTION

Motor competence comprises the coordinated performance of locomotor, stability and object-control skills that enable children to participate in physical activity and provide a foundation for more specialized sport-specific actions. Developmental models describe a reciprocal relationship in which physical activity supports skill acquisition in early childhood, whereas higher motor competence increasingly facilitates continued participation, perceived competence and physical fitness as children grow (Stodden et al., 2008; Robinson et al., 2015). Longitudinal evidences and evidence from research syntheses supports positive associations between motor competence, health-related fitness and physical activity, although the strength and direction of these pathways differ according to age, skill domain and study design (Barnett et al., 2016; Barnett et al., 2022).

Middle childhood is therefore an important period for purposeful movement experiences. At this age, children refine running, throwing, catching and balance while learning to combine these actions under time pressure and changing environmental information. Motor development does not occur through maturation alone; it is shaped by opportunities for practice, instructional quality, task difficulty and the social and physical environment (Iivonen and Sääkslahti, 2014). Evidence from randomized trials and quantitative reviews indicates that structured physical activity and motor-skill programs can improve motor competence, with teacher- or coach-guided practice generally producing more consistent gains than unstructured activity (Van Capelle et al., 2017; Jiménez-Díaz et al., 2019; McDonough et al., 2020).

Improving motor competence may also support the amount and intensity of children's physical activity. Interventions targeting fundamental movement skills have been associated with improvements in skill proficiency and, in some studies, increases in moderate-to-vigorous physical activity. However, the relationship is not uniform and changes in motor competence do not automatically transfer to daily activity outside the instructional setting (Engel et al., 2018; Graham et al., 2022). These findings highlight the need for programs that develop movement quality while also maintaining motivation, repeated participation and meaningful opportunities to apply skills in context.

Mini-handball provides an applied setting in which locomotor and object-control skills are repeatedly combined. Players accelerate over short distances, stop and reorient, track teammates and opponents, regulate throwing force, catch a moving ball and maintain ball control while running. For children aged 8–10 years, these demands should be introduced through simplified rules, adaptable spaces, frequent ball contacts and tasks that permit both success and progressive difficulty. The Youth Physical Development Model similarly recommends that speed, agility, coordination and fundamental movement skills be trained throughout childhood using developmentally appropriate methods rather than being postponed until adolescence (Lloyd and Oliver, 2012).

Game-based practice is particularly relevant because it can integrate physical, perceptual and technical demands while preserving the motivational features of play. Movement games can simplify the full sport while retaining decisions about space, timing, cooperation, passing, catching, shooting and dribbling. Romanian handball methodology literature has recommended such activities for initiation and early technical learning (Roman and Biro, 2003; Constantin and Chirazi, 2019). In adolescent handball, game-based and coordination-focused training has improved sport-related fitness and motor performance, supporting the practical value of contextualized training, although these findings cannot be transferred directly to younger beginners (Buchheit et al., 2009; Radu et al., 2014; Spieszny et al., 2024).

Despite these theoretical and practical arguments, evidence concerning game-based mini-handball programs for female beginners younger than 11 years remains limited. Moreover, early training studies frequently combine technical instruction, general physical preparation and game-based activities, which makes it difficult to isolate the contribution of any single component. The present study therefore aimed to quantify changes in aiming accuracy, throw–catch coordination, 10 m sprint performance and 10 m dribble-sprint performance after 12 weeks of dynamic games integrated into regular mini-handball training. It was hypothesized that performance would improve across all four outcomes, with the largest change in coordination tasks that closely matched the repeated ball-handling content of the intervention.

METHODS

Study design and participants. A single-group pre–post design was used. Fourteen girls aged 8–10 years from the CSU Oradea-KIDS mini-handball team completed the study. At baseline, mean age was 9.14 ± 0.77 years, stature was 137.57 ± 8.03 cm and body mass was 33.58 ± 10.09 kg. All participants had begun organized handball training at the end of February 2024 and were therefore classified as beginners. Baseline testing was conducted on 22 March 2024 and post-testing on 12 June 2024. The same 14 participants provided complete data at both assessments.

Training intervention. The program lasted 12 weeks and included two 80-min sessions per week. Dynamic games occupied approximately 15 min per session in the initial stage, 20 min in the middle stage and up to 25 min in the final stage. The intervention used ten games with easier and more difficult variants. Half of the game objectives emphasized speed, whereas the other half emphasized coordination, while technical content progressed from holding, catching and passing to stationary shooting and multiple dribbling. The remainder of each session consisted of the regular introductory handball program. Table 1 summarizes the progression.

Table 1. Progression of the 12-week game-based training content

Weeks	Dynamic-game dose	Main technical emphasis	Representative games
1–3	≈15 min/session; 2 games	Holding, catching, passing; reaction and short acceleration	Captain Ball; Remember My Name
4–6	≈20 min/session; 3 games	Consolidation of passing; introduction of stationary shooting	Aim at the Cone; Tic-Tac-Toe; Fortress Defender
7–9	≈25 min/session; 3 games	Passing and shooting consolidation; introduction of multiple dribbling	Migrating Birds; Hunter and Rabbits; Number Race
10–12	≈25 min/session; up to 4 games	Multiple dribbling under speed and coordination constraints	Drop and Run; Potato Relay; progressive game variations

Outcome measures. Four tests were administered after a standardized warm-up. For the 10 m sprint, participants started from a standing position and covered a marked 10 m distance at maximal speed. For the 10 m dribble sprint, the same distance was covered while performing multiple dribbles with the preferred hand. Time was recorded in seconds with a handheld stopwatch. The first coordination test assessed aiming accuracy: from 6 m, each participant attempted ten handball throws at a 40 cm circular target fixed to a flat wall and throws landing inside the target were counted. The second test assessed throw–catch coordination: from 4 m, participants attempted ten throws at the same target and then caught the rebounding ball before it contacted the floor; a trial was scored only when both the target hit and catch were successful. The same test procedures were used before and after the program.

Statistical analysis. Individual pre- and post-test scores were analyzed for the present article. Data are reported as mean ± standard deviation. For each outcome, the within-participant difference was calculated in the direction of improvement; lower sprint times were therefore coded as positive improvements. Normality of difference scores was examined with the Shapiro–Wilk test. All four difference distributions were compatible with normality ($p = 0.058$–0.867) and paired-samples t tests were used with two-sided $\alpha = 0.05$. Mean differences are accompanied by 95% CI. Cohen d_z was calculated as the mean paired difference divided by the standard deviation of the paired differences. Wilcoxon signed-rank tests were additionally applied to all four outcomes as sensitivity analyses, particularly because the coordination outcomes were bounded counts. Statistical calculations were performed using JASP software (version 0.19.1).

RESULTS

All participants improved or maintained performance in the two coordination tests. Mean aiming accuracy increased by 1.93 successful trials and throw–catch coordination increased by 3.57 successful trials. Sprint performance also improved: the mean 10 m time decreased by 0.24 s and the dribble-sprint time by 0.22 s. Paired t tests indicated $p < 0.001$ for every outcome, with large standardized within-participant changes. The sensitivity analyses reached the same conclusion (Wilcoxon $p = 0.001–0.002$). Full results are presented in Table 2.

Table 2. Pre–post changes in speed and coordination outcomes (n = 14)

Outcome	Pre-test, mean ± SD	Post-test, mean ± SD	Improvement (95% CI)	t(13)	p	Cohen's d_z
Aiming accuracy (hits/10)	5.86 ± 1.75	7.79 ± 1.42	1.93 (1.20–2.66)	5.69	<0.001	1.52
Throw–catch coordination (trials/10)	2.86 ± 1.17	6.43 ± 1.40	3.57 (2.94–4.20)	12.27	<0.001	3.28
10 m sprint (s)	2.94 ± 0.28	2.70 ± 0.28	0.24 (0.18–0.30)	8.47	<0.001	2.26
10 m dribble sprint (s)	3.46 ± 0.35	3.25 ± 0.35	0.22 (0.15–0.28)	7.26	<0.001	1.94

The largest standardized change occurred in throw–catch coordination (d_z = 3.28), followed by the 10 m sprint (d_z = 2.26), the 10 m dribble sprint (d_z = 1.94) and aiming accuracy (d_z = 1.52). Figure 1 displays this pattern. These paired effect sizes quantify the consistency of change within this sample; they should not be interpreted as controlled treatment effects because there was no comparison group.

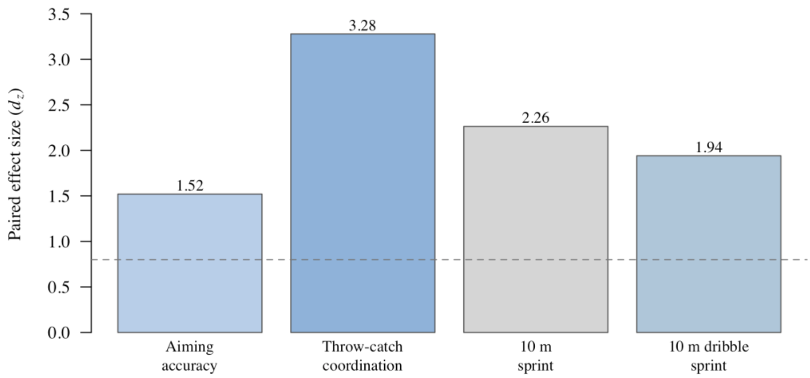

Figure 1. Standardized within-participant improvement across the four outcomes

DISCUSSION

The principal finding was that novice mini-handball players showed substantial improvement in both coordination and short-distance speed after 12 weeks of regular training that incorporated dynamic games. The hypothesis was supported at the level of pre–post association: all four mean changes were statistically different from zero, their confidence intervals excluded no change and nonparametric sensitivity analyses yielded the same direction of evidence. The results are therefore robust as a description of what occurred in this group during the observation period.

The largest change occurred in the throw–catch coordination task. This result is plausible because the intervention repeatedly exposed participants to holding, passing, catching, aiming and recovering the ball under changing game conditions. The test required the same linked sequence of visual target selection, force regulation, rebound anticipation and successful reception. The magnitude of improvement may therefore reflect both developing hand–eye coordination and task-specific learning. Structured programs emphasizing object control are known to improve manipulative motor skills, particularly when children receive repeated, purposeful practice rather than relying on free play alone (Van Capelle et al., 2017; Jiménez-Díaz et al., 2019).

Aiming accuracy improved less than the combined throw–catch test in standardized terms, although the absolute change was still meaningful. Baseline aiming performance was already relatively high, leaving less room for improvement within a ten-trial score. The bounded nature of both coordination measures also creates potential floor and ceiling effects. Future studies should use validated age-appropriate instruments, add more trials, or include several levels of target difficulty to improve measurement precision and distinguish general coordination from familiarity with a single wall task.

The reduction in 10 m sprint time is consistent with the intervention's repeated short accelerations, races, chases, starts in response to signals and relays. Dynamic games can expose children to many maximal or near-maximal bursts without separating conditioning from play. The similar absolute improvement in the dribble sprint indicates that participants became faster while controlling the ball, although the relative gain was smaller than in the sprint without a ball. Dribbling imposes an additional visuomotor and rhythmic constraints and beginners must divide their attention between forward displacement and ball control. This supports a progressive approach in which sprint mechanics and ball control are developed separately and then combined under increasing time pressure.

The findings have practical value for introductory handball. Coaches can allocate a short, structured block of each session to two to four games and progressively modify distance, number of opponents, dominant versus non-dominant hand use, target size and decision rules. The training log suggests that increasing the game block from approximately 15 to 25 min while moving from basic passing to dribbling under pressure was feasible in two weekly sessions. However, coaches should preserve broad movement experiences and avoid interpreting early test gains as evidence for premature specialization.

Several limitations restrict inference. First, the study used a small convenience sample from one female team and had no control group. Maturation, the ordinary handball curriculum, repeated testing and increased familiarity with the coach's instructions may all have contributed to the observed changes. Second, participants were beginners, for whom rapid initial learning is expected. Third, handheld timing can introduce measurement error over 10 m and the number of trials and the best-versus-average timing rule were not documented in sufficient detail. Fourth, the two coordination tasks were study-specific and their reliability and validity were not established. The effect sizes therefore describe within-group change and are likely to be larger than effects that would be obtained against an active comparison group.

A stronger follow-up study should randomly allocate a larger sample to a game-based group and an active control group receiving the same total training time. Electronic timing gates, validated motor-competence measures, blinded assessors, familiarization trials, attendance records and a retention assessment would improve internal validity. Analyses should focus on the group-by-time effect and report uncertainty alongside standardized effects. Such a design would determine whether dynamic games provide benefits beyond those of regular technical instruction.

CONCLUSIONS

Fourteen novice girls aged 8–10 years improved aiming accuracy, throw–catch coordination, 10 m sprint time and 10 m dribble-sprint time during a 12-week mini-handball program incorporating dynamic games. The largest change was found in the coordination task that most closely matched repeated throwing and catching practice. The program provides a feasible applied model for combining speed, coordination and technical learning in introductory handball. Nevertheless, the uncontrolled design supports a conclusion of substantial pre–post improvement, not proof that the dynamic games alone caused the gains.

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