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CHANGES IN AGILITY, ENDURANCE, AND TEAMWORK FOLLOWING SMALL-SIDED GAMES TRAINING AMONG FUTSAL EXTRACURRICULAR PARTICIPANTS: EVIDENCE FROM A HIGH-SCHOOL SETTING

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ABSTRACT

This study examined changes in agility, endurance, and teamwork following small-sided games (SSG) training among students participating in a futsal extracurricular program at SMAN 1 Dukupuntang. The study employed a quantitative approach with a one-group pretest-posttest design involving 20 students. The participants received 16 SSG training sessions conducted three times per week. Agility, endurance, and teamwork were assessed before and after the training period. The data were analysed using the Wilcoxon signed-rank test. The results showed a significant difference in agility scores between the pretest and posttest ($Z = -3.921$, $p < .001$), with the mean test time decreasing from 16.4100 to 16.0045 seconds. Endurance scores also showed a significant difference ($Z = -3.924$, $p < .001$), increasing from a mean of 34.7800 to 36.2350. Similarly, teamwork scores increased from 34.65 to 37.70, with a significant pretest-posttest difference ($Z = -3.169$, $p = .002$). These findings indicate changes in the measured agility, endurance, and teamwork outcomes following the SSG training period. However, because the study did not include a control group, the observed changes cannot be attributed exclusively to SSG training. The findings therefore provide evidence of pretest-posttest changes within the studied group and may provide a basis for further research using controlled designs to examine the contribution of SSG training to these outcomes.

INTRODUCTION

Futsal is a fast-paced intermittent team sport that requires players to repeatedly perform high-intensity actions within a relatively constrained playing area. Its competitive demands involve frequent accelerations, decelerations, changes of direction, and repeated movement sequences, requiring players to maintain physical performance throughout match play (Naser et al., 2017; Ribeiro et al., 2020). A systematic review further indicates that futsal performance is characterised by substantial physical and physiological demands, emphasising the importance of developing physical capacities that enable players to respond effectively to repeated game actions (Spyrou et al., 2020). These demands are particularly relevant in school-based futsal, where training programs need to develop physical capacities while remaining appropriate to the characteristics of adolescent participants.

Among the physical capacities required in futsal, agility is important because players must rapidly change movement direction and velocity in response to continually changing game situations. Agility is not limited to changing direction quickly; it also involves effectively executing movement in response to relevant task demands (Sheppard & Young, 2006). In team sports, agility performance is influenced by physical and perceptual factors and therefore requires training approaches that expose players to repeated movement demands within sport-specific contexts (Paul et al., 2015). Endurance is also essential because futsal involves repeated high-intensity actions interspersed with periods of lower-intensity activity. Players therefore need sufficient endurance capacity to sustain performance across repeated bouts of activity during play (Naser et al., 2017; Spyrou et al., 2020).

Small-sided games (SSG) provide a training approach that reproduces important characteristics of game play while manipulating elements such as the number of players, playing area, and task conditions. Such manipulation can alter the physical, technical, and tactical demands experienced by players (Hill-Haas et al., 2011). From a pedagogical perspective, SSG can also create an environment in which movement and decision-making skills are developed through interaction with game situations rather than through isolated physical or technical exercises (Davids et al., 2013). Systematic reviews have consequently identified SSG as a widely used game-based training approach capable of influencing physical and tactical aspects of team-sport performance (Sarmento et al., 2018; Sarmento et al., 2021).

The relevance of SSG to futsal is also supported by empirical studies examining physical outcomes. Fitrian et al. (2023) reported positive effects of SSG training on VO_2max and passing accuracy among futsal players, while Indrayogi et al. (2023) found an influence of SSG training on passing and endurance ability in a men's futsal team. These findings suggest that the repeated and intermittent activity structure of SSG may provide a training stimulus relevant to the physical demands of futsal. However, evidence concerning SSG should not be interpreted as uniform across all outcomes because responses may depend on the characteristics of the game format, training conditions, participants, and outcome measures (Hill-Haas et al., 2011; Sarmento et al., 2021).

In addition to physical performance, SSG creates a shared game environment in which players must continuously coordinate their actions with teammates. Players make movement and tactical decisions while responding to the positioning and actions of other players, making collective behavior an inherent component of the training environment (Davids et al., 2013). Research on SSG has shown that manipulating game constraints can affect tactical behavior and collective dynamics, indicating that game-based practice can provide opportunities for players to interact and coordinate their actions during performance (Afonso et al., 2020). Thus, examining physical outcomes together with teamwork may provide a broader understanding of how an SSG-based training program relates to performance in a school futsal setting.

Despite the growing evidence concerning SSG, much of the existing literature has focused on adult, competitive, or soccer populations, while evidence involving school-based futsal participants and examining agility, endurance, and teamwork within the same intervention context remains more limited. Existing studies have demonstrated relationships between SSG and physical or tactical outcomes, but the relevance of these findings to

participants involved in extracurricular futsal at the secondary-school level warrants further examination (Sarmento et al., 2018; Sarmento et al., 2021). Moreover, evidence on physical adaptations does not, by itself, establish whether changes in agility, endurance, and teamwork occur following the same training program.

Therefore, this study examined changes in agility, endurance, and teamwork among students participating in extracurricular futsal following an SSG training program at SMAN 1 Dukupuntang. By examining these three outcomes within the same group before and after the intervention, the study seeks to provide an integrated description of changes associated with SSG-based training in a school futsal context. The findings are expected to contribute empirical evidence for applying game-based training approaches in extracurricular futsal programs, particularly regarding physical performance and teamwork.

METHOD

Research Design

This study employed a quasi-experimental one-group pretest–posttest design to examine changes in agility, endurance, and teamwork following a Small-Sided Games (SSG) training program. The design involved an initial assessment (*pretest*), implementation of the SSG intervention, and a subsequent assessment (*posttest*) using the same outcome measures. The SSG intervention was based on its game-based characteristics, in which modified game situations can integrate movement demands, decision-making, and interaction among players (Davids et al., 2013; Hill-Haas et al., 2011). The study was conducted among participants of the futsal extracurricular program at SMAN 1 Dukupuntang, Cirebon, Indonesia. Data collection was conducted from 8 July to 8 August 2026. The intervention consisted of 16 training sessions over approximately one month, held three times per week. The same participants completed both the pretest and posttest assessments.

Participants

The participants were students who participated in the futsal extracurricular program at SMAN 1 Dukupuntang. The study involved 20 participants, and the participants who met the study requirements were included in the intervention and completed both measurement occasions. Using a single participant group was consistent with the one-group pretest–posttest design adopted in this study. Because SSG is based on modified game situations in which players are repeatedly involved in movement, decision-making, and interaction with teammates, the intervention was implemented within the existing futsal extracurricular setting rather than under an isolated laboratory training condition (Davids et al., 2013).

Small-Sided Games Intervention

The intervention consisted of an SSG-based training program delivered over 16 sessions, with three sessions per week. SSG was used as the principal training approach because it retains important features of gameplay while manipulating game conditions to increase players' involvement in relevant actions. Physiological responses to SSG can vary depending on the characteristics of the game format and training conditions, making the structure of the training environment an important component of the intervention (Hill-Haas et al., 2011). The intervention was conducted in the context of futsal extracurricular training. The game-based

nature of SSG allowed participants to perform movement and decision-making actions within representative game situations rather than through isolated drills. This approach aligns with the view that small-sided and conditioned games can facilitate the development of movement and decision-making skills through interaction with the constraints of the playing situation (Davids et al., 2013).

Measures

Agility

Agility was assessed during the pretest and posttest to determine changes in participants' ability to perform rapid movement actions. Agility is commonly understood as rapid movement and changes in direction, although in team sports it also involves the interaction between physical and task-related demands (Sheppard & Young, 2006). The same agility testing procedure was applied before and after the intervention to ensure comparability of the two measurements. Agility performance was expressed as completion time, with a lower time indicating better performance.

Endurance

Endurance was assessed before and after the SSG intervention using the same testing procedure. The assessment was intended to capture participants' endurance capacity under the standardised testing conditions used in the study. An intermittent endurance assessment is relevant to the physical characteristics of futsal, in which players repeatedly perform high-intensity activities interspersed with lower-intensity periods. A futsal-specific intermittent shuttle protocol has also been examined as an approach for representing the physical demands of futsal match play (Freitas et al., 2017).

Teamwork

Teamwork was assessed using a questionnaire administered during both the pretest and posttest. The assessment focused on participants' teamwork performance within the context of futsal participation. The conceptualisation of teamwork in this study was informed by the understanding that effective teamwork involves coordinated interaction among members working toward a shared task objective. Salas et al. (2005) identified teamwork as a multidimensional construct involving several interrelated team processes, while Driskell et al. (2018) emphasised coordination and collaboration as fundamental elements of effective teamwork.

Data Collection Procedure

Data collection was conducted in three stages. First, participants completed the **pretest** to establish baseline measurements of agility, endurance, and teamwork. Second, participants undertook the SSG training intervention for **16 sessions**, conducted three times per week over approximately one month. Third, after completing the intervention, participants completed the posttest using the same measurement procedures used during the pretest. Using the same participants and measurement procedures at both time points enabled within-participant comparison of pre-intervention and post-intervention scores.

Data Analysis

Descriptive statistics summarised pretest and posttest results for each outcome. The analysis included the mean, minimum, and maximum values for agility, endurance, and

teamwork. Because the study compared paired observations obtained from the same participants before and after the intervention, the Wilcoxon signed-rank test was used to examine differences between pretest and posttest scores. The analysis was conducted separately for agility, endurance, and teamwork. Statistical significance was determined at α = .05. The percentage change was also calculated descriptively usin: $P = \frac{Posttest - Pretest}{Pretest} \times 100\%$. For agility, interpretation of the percentage change considered the direction of the measure because agility was expressed as completion time; therefore, a reduction in completion time represented improved performance.

RESULT

Descriptive Results

The study involved 20 students participating in the futsal extracurricular program at SMAN 1 Dukupuntang. Data were collected through a pretest before the intervention, followed by 16 Small-Sided Games (SSG) training sessions held three times per week over approximately one month, and a posttest after completion of the intervention. Three outcomes were examined: agility, endurance, and teamwork. Descriptive analysis was first conducted to identify the direction and magnitude of change between pretest and posttest measurements. We examined mean, maximum, and minimum values for each outcome.

Agility

Table 1. Descriptive Statistics of Agility

Statistic	Pretest	Posttest	Change
Mean (s)	16.41	16.00	−0.41
Maximum (s)	18.38	17.75	−0.63
Minimum (s)	15.27	15.06	−0.21

The descriptive results show a reduction in agility-test completion time from a mean of 16.41 seconds at pretest to 16.00 seconds at posttest, corresponding to an absolute reduction of 0.41 seconds. Because the agility outcome was measured in seconds, a lower value represents faster completion of the test and therefore a more favorable performance direction. The mean change therefore indicates improved agility performance following the intervention period. The change was also observed across the observed range of scores. The maximum completion time decreased from 18.38 to 17.75 seconds, a reduction of 0.63 seconds, while the minimum completion time decreased from 15.27 to 15.06 seconds, a reduction of 0.21 seconds. Thus, the descriptive shift was not limited to the mean alone; both ends of the observed range moved toward shorter completion times. In relative terms, the mean reduction from 16.41 to 16.00 seconds represents approximately a 2.50% decrease in completion time. This percentage is descriptive and does not, by itself, establish statistical significance. The inferential analysis was therefore used to determine whether the paired pretest–posttest change was statistically supported.

Endurance

Table 2. Descriptive Statistics of Endurance

Statistic	Pretest	Posttest	Change
Mean	34.78	36.24	+1.46
Maximum	37.50	40.20	+2.70
Minimum	31.40	32.90	+1.50

The descriptive analysis showed an **increase in endurance performance** from a mean of 34.78 at pretest to 36.24 at posttest. The absolute increase was **1.46 points**. In contrast to agility, where lower completion time represents better performance, the endurance measure was interpreted so that higher scores indicate better performance. The increase was also evident in the observed range. The maximum score increased from 37.50 to 40.20, representing a gain of 2.70 points, while the minimum score increased from 31.40 to 32.90, representing a gain of 1.50 points. Consequently, the posttest distribution showed higher observed values at both the upper and lower ends of the reported range. The mean increase corresponds to approximately a **4.20% increase relative to the pretest mean**. As with agility, this percentage represents the magnitude of descriptive change and is not equivalent to an effect-size estimate or a causal effect. We then assessed statistical evidence for the paired change using the Wilcoxon signed-rank test.

Teamwork

Table 3. Descriptive Statistics of Teamwork

Statistic	Pretest	Posttest	Change
Mean	34.65	37.70	+3.05
Maximum	40.00	40.00	0.00
Minimum	27.00	29.00	+2.00

The descriptive results for teamwork showed an increase in the mean score from 34.65 at pretest to 37.70 at posttest, representing an absolute increase of 3.05 points. The maximum score remained unchanged at 40.00, whereas the minimum score increased from 27.00 to 29.00. The descriptive pattern therefore indicates that the principal change occurred in the central tendency and lower boundary of the observed scores rather than in the maximum value. The unchanged maximum indicates that participants who reached the highest observed score at pretest remained at that level at posttest, while the increase in the minimum suggests that the lowest observed performance moved upward. The mean increase represents approximately an 8.80% increase relative to the pretest mean. This descriptive change provides an initial indication of improvement in teamwork scores, but statistical testing was required to

determine whether the paired change was sufficiently systematic to reject the null hypothesis of no difference.

Normality Assessment

Before selecting the inferential procedure, we examined the distribution of each pretest and posttest outcome using the Shapiro–Wilk test. The analysis was performed for all six measurement distributions because each outcome was observed at two time points.

Table 4. Shapiro–Wilk Normality Test

Outcome	Measurement	Statistic	*p*
Agility	Pretest	0.928	.142
Agility	Posttest	0.902	.045
Endurance	Pretest	0.936	.205
Endurance	Posttest	0.931	.164
Teamwork	Pretest	0.918	.089
Teamwork	Posttest	0.730	.001

The Shapiro–Wilk results show that the assumption of normality was not consistently met across the six distributions. The pretest agility distribution had $p = .142$, while its posttest distribution had $p = .045$. For endurance, the pretest and posttest distributions produced $p = .205$ and $p = .164$, respectively. For teamwork, the corresponding values were $p = .089$ and $p = .001$. Using the conventional criterion of $p < .05$, the posttest agility and posttest teamwork distributions did not meet the normality criterion. Therefore, the dataset as a whole could not reasonably be treated as uniformly normally distributed for the planned paired comparisons. This result was important for selecting the inferential procedure. Because the study involved paired observations from the same 20 participants and the normality assumption was not consistently met, the subsequent analysis used the Wilcoxon signed-rank test, a non-parametric procedure for paired observations. The normality analysis therefore served as an analytical decision point rather than as a substantive finding about the effectiveness of the intervention. It established the statistical basis for proceeding with a non-parametric paired comparison.

Wilcoxon Signed-Rank Test

The Wilcoxon signed-rank test was subsequently applied separately to the three outcomes to examine whether statistically significant differences existed between pretest and posttest measurements.

Table 5. Wilcoxon Signed-Rank Test Results

Outcome	Z	*p* (2-tailed)	Interpretation
Agility	−3.921	< .001	Significant pretest–posttest difference
Endurance	−3.924	< .001	Significant pretest–posttest difference

Outcome	Z	*p* (2-tailed)	Interpretation
Teamwork	−3.169	.002	Significant pretest–posttest difference

The Wilcoxon signed-rank analysis showed statistically significant pretest–posttest differences for all three outcomes. For agility, the test produced Z = −3.921, p < .001. For endurance, Z = −3.924, p < .001; for teamwork, Z = −3.169, p = .002. All three *p* values were below the predetermined significance level of .05.

Agility

The agility result indicates a statistically significant difference between pretest and posttest performance. This inferential finding is consistent with the descriptive result, in which mean completion time decreased from 16.41 to 16.00 seconds. Because lower completion time indicates faster performance, the statistically significant change was in the direction of improved agility performance. Thus, the descriptive and inferential results converge: the observed reduction in completion time was not merely a difference in the sample means but was accompanied by statistically significant evidence of a systematic pretest–posttest difference.

Endurance

For endurance, the Wilcoxon test also demonstrated a statistically significant pretest–posttest difference, with Z = −3.924 and p < .001. This result corresponds with the descriptive increase in mean performance from 34.78 to 36.24. The descriptive change indicates higher posttest endurance scores. Therefore, the statistical finding supports a significant pretest–posttest change in endurance performance following the intervention period.

Teamwork

The teamwork analysis produced Z = −3.169 and p = .002, indicating a statistically significant difference between pretest and posttest scores. This finding is consistent with the increase in mean teamwork score from 34.65 to 37.70. Unlike agility, where improvement is represented by a reduction in the numerical value, the teamwork measure showed improvement through an increase in the score. The descriptive and inferential findings therefore point in the same favourable direction.

Integrated Analysis of the Three Outcomes

The three outcomes demonstrated a consistent directional pattern of pretest–posttest change. Agility improved through reduced completion time, whereas endurance and teamwork improved through increases in their respective scores. The magnitude of the descriptive changes also differed across outcomes. The mean agility time decreased by 0.41 seconds, equivalent to approximately 2.50% relative to the pretest mean. Endurance increased by 1.46 points, or approximately 4.20%, while teamwork increased by 3.05 points, or approximately 8.80%. These percentages are descriptive indicators of change and should not be interpreted as standardised effect sizes. The inferential analysis provided additional evidence that each pretest–posttest difference was statistically significant. The strongest statistical evidence, in terms of the reported p-value, was observed for agility and endurance (p < .001), while teamwork also showed a statistically significant difference (*p* = .002).

Importantly, the three Wilcoxon tests were conducted separately. Therefore, the results demonstrate statistically significant paired differences for each outcome individually; they do not constitute a single multivariate test of a simultaneous intervention effect across agility, endurance, and teamwork.

DISCUSSION

The findings showed differences between the pretest and posttest scores for agility, endurance, and teamwork after the small-sided games (SSG) training program. Agility performance improved as indicated by the lower mean time after the intervention, while endurance and teamwork scores increased. The Wilcoxon signed-rank tests indicated statistically significant differences for agility ($Z = -3.921$, $p < .001$), endurance ($Z = -3.924$, $p < .001$), and teamwork ($Z = -3.169$, $p = .002$). These findings indicate that the participants' scores differed between the two measurement occasions following the SSG training period. However, because the study used a one-group pretest-posttest design without a control group, the observed changes cannot be attributed exclusively to SSG training.

The agility results showed a decrease in mean completion time from 16.4100 seconds at pretest to 16.0045 seconds at posttest, representing a change of 0.4055 seconds. The significant Wilcoxon result indicates that agility scores differed significantly between the two assessments. This finding is consistent with research describing agility as an important component of performance in team sports and emphasizing the role of training and sport-specific movement demands in agility performance (Paul et al., 2015; Sheppard & Young, 2006). Lima and Oliveira-Silva (2025) also reported improved agility performance following SSG training in the 505 test. In addition, Menezes et al. (2021) examined the relationship between motor coordination and physical and perceptual-cognitive factors associated with agility in young soccer players. Taken together, these studies provide a relevant context for the present finding, although differences in participants, testing procedures, and training conditions should be considered when comparing the results.

For endurance, the mean score increased from 34.7800 at pretest to 36.2350 at posttest, with a mean change of 1.4550. The Wilcoxon test showed a statistically significant difference between the two measurements ($Z = -3.924$, $p < .001$). Previous studies have reported changes in endurance-related performance following SSG-based training in futsal. Fitrian et al. (2023) reported positive changes in VO_2max following SSG training, while Indrayogi et al. (2023) examined SSG training in relation to passing and endurance ability in a men's futsal team. Miftachurochmah (2023) also examined SSG and coordination training in relation to aerobic endurance among male futsal athletes, and Wenly et al. (2021) reported the use of an SSG-based model for endurance training among beginner women futsal players. These findings are relevant to the present result because they similarly examine SSG in relation to endurance-related outcomes. Nevertheless, the present study only demonstrates a significant pretest-posttest difference in its measured endurance score and does not establish that the change was caused solely by the SSG program.

Teamwork scores also increased, from a mean of 34.65 at pretest to 37.70 at posttest, representing a change of 3.05 points. The Wilcoxon test indicated a statistically significant

difference between the two measurements (Z = −3.169, p = .002). The finding can be considered in relation to literature that conceptualizes teamwork through processes and competencies related to communication, coordination, and collaboration among team members. Salas et al. (2005) proposed a framework for understanding core components of teamwork, while Driskell et al. (2018) discussed the foundations of teamwork and collaboration. Leggat (2007) likewise emphasized teamwork competencies in effective team functioning. Amoroso et al. (2021) reviewed psychosocial constructs related to teamwork in sport. In the context of the present study, the increase in teamwork scores indicates a difference in the participants' measured teamwork between pretest and posttest. The result should not, however, be interpreted as evidence that SSG alone produced the observed change.

Overall, the three outcomes showed statistically significant pretest-posttest differences following the SSG training period. The changes were reflected in lower agility-test time and higher endurance and teamwork scores. The magnitude of change was not identical across outcomes, with the largest relative change in the teamwork score, followed by endurance and agility when expressed on their respective measurement scales. These findings suggest that the SSG program was accompanied by changes across the three measured outcomes in this group of students. However, the interpretation remains limited to the observed pretest-posttest changes because the study did not include a comparison group and the outcomes were analysed separately. Therefore, the findings provide evidence of change following the training period rather than definitive evidence of an exclusive causal effect of SSG training.

CONCLUSION

This study examined changes in agility, endurance, and teamwork among students participating in the futsal extracurricular program following a small-sided games (SSG) training program. The results showed statistically significant differences between pretest and posttest measurements for all three outcomes. Agility performance improved, as indicated by a reduction in mean test time from 16.4100 to 16.0045 seconds (Z = −3.921, p < .001). Endurance scores increased from 34.7800 to 36.2350 (Z = −3.924, p < .001), while teamwork scores increased from 34.65 to 37.70 (Z = −3.169, p = .002). These findings indicate that participants showed changes in measured agility, endurance, and teamwork outcomes after the SSG training period. The findings provide evidence of pretest-posttest change following the SSG training program within the studied group. However, the one-group pretest-posttest design and absence of a control group limit the extent to which these changes can be attributed exclusively to SSG training. Therefore, the results should be interpreted as evidence of changes observed after the intervention rather than definitive evidence of a causal effect of SSG. Further studies using a control or comparison group and more detailed intervention and measurement procedures are needed to examine the contribution of SSG training to these outcomes more rigorously.

ADDITIONAL INFORMATION

Authors should provide the following information where applicable. Statements that are not relevant to the manuscript may be omitted.

Statement	Description
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Author Contributions	A.S.: Conceptualisation, Methodology, Investigation, Data Curation, Formal Analysis, Writing—Original Draft. I.P.: Methodology, Formal Analysis, Writing—Review & Editing, Supervision. I.: Writing—Review & Editing and Supervision. All authors have read and approved the final version of the manuscript.
Conflict of Interest	The authors declare that there are no financial or non-financial **conflicts of interest** related to this research or its publication.
Data Availability Statement	The data generated and analyzed during this study are available from the corresponding author upon reasonable request**.** The data are not publicly available because they contain individual-level information from a small group of student participants, and unrestricted disclosure could potentially compromise participant confidentiality.

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