

36 **Abstract**

37 The multi-sport approach is suggested as a natural method towards developing physical fitness among
38 young athletes. Coaches were urged to apply this approach with emphasis on a fun activity, active play and
39 small-sided games in order to maximize the benefit of this approach. **PURPOSE:** The purpose of this study
40 is to investigate the effects of a multi-sport approach towards the development of agility performance
41 among adolescents. **METHODS:** A quasi-experimental design was used for the study. Forty adolescents
42 (n= 40), age between 13 to 14 years old randomly assigned to the control group (CG) (n= 20) and
43 experimental group (EG) (n= 20). The EG multi-sport approach consisted of playing football, futsal, sepak
44 takraw, volleyball, basketball and netball. While, the CG performed football and futsal training only, thrice
45 for 12 weeks. The agility performance was assessed three times using the Quadrant Jump test. One during
46 pre-test (baseline), second on post-test 1 (week 6) and third on post-test 2 (week 12). **RESULTS:** In the
47 EG group, the agility performance increased significantly compared to CG with $F(1, 38) = 64.53, p > .0001$.
48 The agility performance was improved by 5.85 mean total of jumping in the EG in week 12.
49 **CONCLUSION:** The multi-sport training approach increased the agility performance among adolescents.
50 As a conclusion, this training approach is more effective and should become a training routine at any level
51 of sport development.

52 **Keyword:** Multi-sport, Multilateral Development, Quadrant Jump Test, Sport Coaching, Young Athlete.

53 **Introduction**

54 Early involvement in sports and physical activity significantly contribute to the development of motor
55 skills of individual especially among children and adolescents. One of the key factors underpinning the
56 development of the motor skills occurred due to the learning process during participation in any sport
57 activities (Greco, 2020). Consequently, when someone developed and improved on their motor skills is
58 therefore thought to be associated with sports performance. Performance in sports mostly determined by
59 the athlete's motor skills, physical fitness, technical, tactical and mental characteristics (Bangsbo, 2015;
60 Jakiwa, Atan & Azli, 2020a). Therefore, coaches and parents will make sure their players or children
61 acquire with enough fundamental skills in order to excel in sports.

62 One of the crucial factor needs to consider for the adolescent's development is the type of training. Based
63 on Kliethermes et al. (2021) and Bompa and Buzzichelli (2018), there are two types of training suggested
64 for children; 1) multilateral training and 2) specialization training. Multilateral training aims to improve
65 the basic bio-motor abilities, such as endurance, strength, speed, flexibility and coordination (Bompa &
66 Buzzichelli 2018). One of the approach that supported the multilateral training is multi-sports training
67 (Popovic et al., 2020). The multi-sports are an approach that applied training program through variety of
68 sports such as football, volleyball, basketball, futsal and so on (Fischetti & Greco, 2017). The multi-sport
69 provides different exposure and more effective in developing a range of fundamental movement skills
70 naturally (Popovic et al., 2020). Whereas, the specialization or specific sport training is typically defined
71 as intense training in a single sport to the exclusion of all other sports (Kliethermes et al., 2021). The aim
72 of this training is to developed young elite athlete as soon as possible and become champion in young age
73 (Bompa & Buzzichelli, 2018).

74 Krasilshchikov (2013) suggested a combination of different activities such as running, ladder, gym ball,
75 dumbbell and medicine ball exercises were significantly improved physical fitness among participants.
76 Similarly, Fischetti and Greco (2017) found the exposure to multi-sport like volleyball, basketball,
77 handball and soccer with variety of training exercises such as running, walking, circuits and sprint

78 intervals in training helps adolescents to improve on their agility performance. In addition, Popovic et al.
79 (2020) also agreed that training with ball game-based exercises were significantly improved agility
80 performance among children. Such information should prove multi-sports training was beneficial to
81 develop and improving physical fitness among young athlete.

82 In addition, multi-sport athletes have a higher rate of long-term success than their single-sport counterparts
83 (Myer et al., 2015). Besides, multi-sport athletes are more consistent performance with fewer injuries, and
84 they are also more likely to be active adults (Rugg et al., 2018). Overuse injuries happened when an athlete
85 repeatedly performs the same motion over time and athletes that participate in several sports have less
86 injury and more opportunities to recover and grow diverse muscle groups, tendons, and ligaments (Myer
87 et al., 2015). Other than injuries, burnout or dropout is another factor that need to be concerned. As stated
88 by Giusti et al, (2020), Athletes who specialized reported higher levels of burnout than athletes who
89 participate in sport diversification. Therefore, in order to reduce injuries, burnout and also to promote
90 long-term success, it is highly recommended for coaches to apply this multi-sport training with emphasis
91 on a fun activity, active play and small-sided games in order to maximize the benefit of the training
92 method.

93 As mention earlier, multi-sport training tends to improve the basic bio-motor abilities, such as endurance,
94 strength, speed, flexibility and coordination (Bompa & Buzzichelli 2018). However, the effect of multi-
95 sport training towards agility fitness component has yet to discover. As knowing, agility is one of
96 important components in skill related fitness. It can be described as a complex psychomotor skill with the
97 ability to stable the body position and change the direction of movement with the most minimal time
98 (Shamshuddin et al., 2020). While, Pojskic et al. (2018) defined an agility as a fast whole-body movement
99 with change of speed and direction in response to any stimulus. There are two factors involved in agility
100 that are the rapid change of direction and also perceptual and decision-making process (Pojskic et al.,
101 2018). In team sport such as basketball, futsal and football, agility component are crucial and central to
102 successful performance. Children should be exposed and train to be agile in order for them to achieve

103 success in sports. Currently, there is lack of study regarding multi-sports and specific sport training
104 towards agility performance. Hence, the aim of this current study is to investigate the effects of multi-
105 sports approach towards the development of agility performance among adolescents.

106 **Methods**

107 **Participants**

108 A total of forty (n=40) adolescents were volunteered to participate in this study (13.50 ± 0.51 years;
109 145.27 ± 5.89 cm; 36.68 ± 4.88 kg). All participants are male aged between 13 to 14 years old, currently
110 active in sport and physical activity with no history of injury. The determination of the sample size was
111 calculated based on statistical power analysis method (Cohen, 1998). In this study, there are four factors
112 to considered in order to obtain appropriate sample size such as significance level, effect size, power
113 desires and variance expectations (Das, Mitra, & Mandal, 2016). Based on Cohen's (1998)
114 recommendation, this study sample size was at a power of .80 and the effect size of .07 is 12. Therefore,
115 12 participants are needed for this study. However, to avoid any mortality effects that may occurred during
116 the study, 20 participants for each groups was selected. Along 12 weeks of study, all participants are able
117 to finish their training without any injury or mortality effects.

118 **Design of the Study**

119 This study was conducted through quasi-experimental design to understand the cause and effect between
120 an independent and dependent variable. This design was selected due to the effectiveness in evaluate the
121 effect of mutli-sport intervention (independent variable) to the agility performance (dependent variable)
122 among participants (adolescents). Data were collected for 12 weeks at three different time points that is
123 pre-test (baseline), post-test 1 (week 6) and post-test 2 (week 12). According to Miller, Schwarz and Talke
124 (2017) time series design is an appropriate method for this study where it's involving more than two
125 measurements. Hence, the reliability of this study were improved due to application of this design.

126

127 **Procedure**

128 Prior to the data collection, all participants were provided with informed written consent form regarding
129 the benefits and potential risks of the study. The participants were also informed and ensured that
130 participation is voluntary and their information will be kept strictly confidential. A total of 40 participants
131 successfully had their parents' permissions and they were randomly assigned into 2 groups; Control Group
132 (n=20) and Experimental Group (n=20). The Experimental Group (EG) performed multi-sport
133 intervention such as playing football, futsal, sepak takraw, volleyball, basketball and netball. While, the
134 Control Group (CG) performed football and futsal training only. The selection of different types of sport
135 in EG was due to several factors such as it is a team sports, can modified into small-sided games and most
136 importantly incorporates changing the direction like twisting, turning quickly

137 All participants undertook one trial to familiarized with the test. The research assistant or tester explained
138 in detail the testing protocol and demonstrated the Quadrant Jump Test to the participants. During the test
139 session, all participants were urged to warm up approximately in 10 to 15 minutes for physical and mental
140 readiness (Jakiwa at al., 2020b). When they are ready, the test was performed with the assistance of three
141 testers; tester 1, tester 2 and tester 3 responsible as time keeper, to count total jumps and to record test
142 errors respectively.

143 **Instrument**

144 The agility performance was assessed through Quadrant Jump test (Sabin & Marcel, 2016). The test was
145 selected because it can assess the ability of changing the movement by jumping. Equipment requirements:
146 stopwatch, marker tape and flat surface. Quadrant squares are marked with marking tape and numbers 1,
147 2, 3 and 4 were assigned as shown in Figure 1. To begin the test, subjects required to start at the starting
148 mark. Participants need to hop with both of their feet according to numbers in the square (1, 2, 3 and 4)
149 for 10 seconds. Subjects were asked to stop the test when a stop signal was given by the tester. In this test,
150 three testers are required to assist the head of researcher. The assistant 1 as a time keeper, assistant 2 to

151 calculate the number of jumps and the assistant 3 to calculate the number of errors committed. Two trials
152 were given to the participants and the best trial was calculated as a data score. A half of point (1/2) is
153 deducted for each time a subject commits an offense. The commons offense they did including the foot
154 touching the line or landing in a wrong square.

155 **Multi-Sport Intervention**

156 The participants in CG were followed the specific training where they become the trainees in the available
157 futsal and football academy. While, the EG were followed the multi-sport training approach led and
158 instructed by the head of researcher. The multi-sport intervention tends to not only for improving agility
159 among participants but also to provide enjoyment while being able to avoid injuries and dropouts. Figure
160 2 showed the characteristics of multi-sport intervention. There are eight characteristics were applied in
161 multi-sport intervention including fun activities or drills, game or playing orientation, unstructured
162 activities, socialization with other participants, competition elements, variety of drill or sports and less
163 involving the law of the game.

164 Prior to the intervention session, all participants were followed the structure of training designed by the
165 head of researcher. 1) Dynamic warm-up for 10 to 15 minutes. Various movements involved such as fun
166 activity, individual and group stretching, changeable speed and many more activities based on the
167 objective of training session. 2) Main training part for 40 to 60 minutes. Game like situation and small-
168 sided games are the main part of the training. Participants were divided into several group and they were
169 trained through playing. All participants are free to play with less involvement of law of the game. 3)
170 Cool-down for 10 to 15 minutes. Several movements were involved form head to toe in static manner.
171 The coach also give feedback, comments and motivation to the participants in order for them to improve
172 performance.

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Table 1: Multi-Sport training intervention for the duration of 12 weeks

No.	Sports	Description	Activities
1	Futsal	Modification of sports activities based on the courts' size and the number of players used.	1v1, 2v2, 3v3, 4v4 and 5v5
2	Basketball		1v1, 2v2, 3v3, 4v4 and 5v5
3	Volleyball		1v1, 2v2, 3v3, 4v4 and 5v5
4	Football		1v1, 2v2, 3v3, 4v4 and 5v5
5	Netball		1v1, 2v2, 3v3, 4v4 and 5v5
6	Sepak takraw		1v1, 2v2 and 3v3

176

177 Table 1 showed the multi-sport training intervention for the duration of 12 weeks. Each week the training
178 was conducted on every Monday, Wednesday and also Friday for two hours each. Although the training
179 intensity was set at a low and moderate level yet it was considered adequate for the participants. The
180 multi-sport intervention aims to give participants to experience the variety of sports and to develop their
181 motor skills performance naturally. Hence, this study was selecting six different type of sports namely
182 football, futsal, sepak takraw, volleyball, basketball and netball. All drills, activities and games were based
183 on game like situation and small-sided game (Table 1).

184 **Data Analysis**

185 Data are presented as descriptive statistics (mean and standard deviation). While, the Repeated Measure
186 ANOVA Analysis was used to measure the effects of multi-sport intervention towards agility performance
187 among adolescents (Azli et al., 2020). All statistical analyses were performed using Statistical Package
188 for Social Science (SPSS) version 25.0 with the statistical significance level was set at $p \leq 0.05$.

189 **Results**

190 Table 2 showed the descriptive statistics of mean agility performance between groups and time. In pre-
191 test (baseline phase) CG recorded with total of 16.80 ± 1.28 mean of agility performance while EG
192 recorded total of mean agility jump is 17.20 ± 1.01 jumps. After 6 weeks of study, the CG with traditional
193 training performed 18.40 ± 1.35 jumps of mean agility performance while EG performed 19.45 of mean

194 jumps for agility performance. In final test after 12 weeks of study, the EG with multi-sport intervention
 195 were performed better with mean of jumps is 23.05 ± 1.05 compared to mean agility performance during
 196 pre-test and post-test 1. Similarly, CG also performed better agility performance compared to pre-test and
 197 post-test 1 where the mean jumps of agility performance in post-test 2 is 20.10 ± 1.21 . The mean of agility
 198 performance between groups and time were showed more interestingly and easy to understand in form of
 199 graphic (Figure 3).

200 Table 2: Descriptive Statistics of mean agility between groups and time

Test Phase	Group	Mean	Std. Deviation
Pre-test	Control group	16.80	1.28
	Experimental group	17.20	1.01
Post-test 1	Control group	18.40	1.35
	Experimental group	19.45	.99
Post-test 2	Control group	20.10	1.21
	Experimental group	23.05	1.05

201
 202
 203 Based on analysis of Repeated Measure ANOVA between CG and EG (Table 3), the agility performance
 204 indicated $F(1, 38) = 64.53, p > .001$. It showed that there is a significant difference between groups. As
 205 found, both of the training are positively improved the agility performance among participants in 12 weeks
 206 of study. However, that EG performed better compared to CG.

207 Table 3: Tests of between-subjects' effects of agility performance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	44083.33	1	44083.33	13422.81	.00
Group	64.53	1	64.53	19.65	.00
Error	124.80	38	3.28		

208
 209
 210 **Discussion**

211 The aim of this study is to investigate the effects of a multi-sport intervention towards the agility
 212 performance among adolescents aged 13 to 14 years old. The main finding of this study is there is a

213 significant difference in agility performance between the CG and EG where participants in multi-sport
214 training performed better with 34.01% of improvement compared to participants in specific training with
215 only 19.64% of improvement. Besides, in this present study findings showed that both training method
216 increased the agility performance over time. Where, CG improved from 16.80 to 20.10 of repetition and
217 EG improved from 17.20 to 23.05 of repetition.

218 The results of current study were similar to previous research by Popovic et al. (2020) where they found
219 that the structured of multi-sport program led to a positive improvement in physical fitness among 5 to 6
220 years old children compared to formal training program. Study by Fischetti and Greco (2017) suggested
221 that multilateral training combined with different types sports and activities were demonstrated effectively
222 in improving physical capacity and motor skills among youth aged 13 to 14 years old. The multilateral
223 training through multi-sport approach found that participants with aged 8 to 10 year showed improvement
224 in technique, power, expressiveness and rhythm of Karate after 8 weeks of training (Greco, 2020). As
225 discovered by Krasilshchikov (2013), the training with different sports and activities were significantly
226 improved the physical fitness among 10 year children. The finding from the previous study showed that
227 multi-sport and multilateral training was affects the children and adolescents from aged 5 to 14 years old.
228 The effects not only limited to improved physical fitness but also improved the motor skills, technique
229 and rhythm (tempo) in their sports.

230 The combination of a variety of sports in training involved fundamental or gross and fine motor skills and
231 also ball game-based exercises were significantly improved agility performance among children (Popovic
232 et al., 2020). In addition, several sports and activities were applied by Fischetti and Greco (2017) including
233 volleyball, basketball, handball and soccer and also variety of training exercises such as running,
234 walking, circuits and sprint intervals improved physical fitness especially on agility performance
235 among participants. Krasilshchikov (2013) suggested that the application of ladder and gym ball exercise,
236 dumbbell exercises, medicine ball exercise and running were significantly improved physical fitness
237 among participants. As present study, the multi-sport approach was become core for the study. Six types

238 of sports were included in training intervention namely football, futsal, sepak takraw, volleyball,
239 basketball and netball.

240 As stated by Rugg et al. (2018), athletes who practice multi-sport approach during early age tend to played
241 in more games than single-sport athletes by approximately 5.4%, or 4.4 games per season. Several reasons
242 could have contributed to the greater number of games played by multisport athletes included had fewer
243 injuries and better overall skills than single sport athletes (Rugg et al., 2018). In fact, injury is one of the
244 crisis may happened to athlete and lead to physical and mental detriments. Study by DiCesare et al.
245 (2019) stated that sport specialization athletes was linked to musculoskeletal injury and greater
246 variability in the between-joint coupling at the hip and knee in the sagittal plane. In addition, the
247 multisport athlete's early exposure to a variety of sports improved the technical and tactical
248 aspects of their game (Rugg et al., 2018). Therefore, when compared to elite professional athletes
249 who only participate in one sport in high school, those who participate in numerous sports into
250 high school may have more productive, healthy careers in terms of games played, injury
251 avoidance, and career longevity.

252 Although, multi-sport approach showed significant improvement however single sport or specific training
253 also demonstrated slightly improvement in agility performance among adolescents. Several study were
254 found that specific training i.e. single sport training able to improved physical fitness and performance
255 (Granacher & Borde, 2017; Guidetti et al., 2010; Ericsson, Krampe, & Tesch-Römer, 1993). The sport
256 specific training in combination with physical education improved physical fitness of 9 and 10 years of
257 children (Granacher & Borde, 2017). Other than that, Guidetti et al. (2010) found that participants were
258 improved their balance and leg power through application of specific training.

259 This current study contributes to understanding the different type of training that may improve
260 performance among adolescents. However, the selection of training should consider the physiological
261 growth, development and chronological age of individual (Hannon et al., 2020; Jasni et al., 2022). In this

262 study, the multi-sport approach was considered better approach for adolescents. The characteristics such
263 as work in a group (Popovic et al., 2020), low to medium intensity of training (Cataldi et al., 2019) and
264 fun (Krasilshchikov, 2013) made this training approach interesting and effective for adolescents. While,
265 Smucny, Parikh and Pandya (2015) stated that specializing in specific training during young ages has
266 been shown to be detrimental both physically and emotionally, placing the body at risk structurally and
267 burnout. Therefore, parents and coaches should be careful when applying any kind of training approach
268 to children and adolescents.

269 **Conclusion**

270 In conclusion, the present study indicates that multi-sport training intervention and specific training were
271 improved agility performance among adolescents aged 13 to 14 years old. However, the multi-sport
272 training increased agility performance significantly better compared to specific training. The application
273 of multi-sport training characteristics such as fun activity, game orientation, unstructured activities,
274 socialization with others trainee, competition elements and less involvement of sports law were very
275 important for adolescents in order to followed effortlessly the training demands. For further research, the
276 multi-sport and specific training need to study in depth with the measurements of all components of
277 physical fitness and gender differences.

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280 **Conflict of Interest**

281 The present study has no financial support from any agency. Therefore, there is no conflict of interest and
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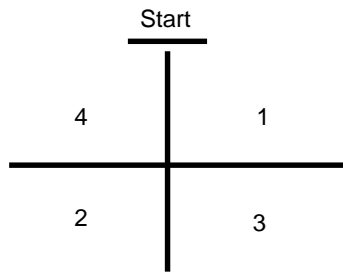
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Figure 1: The illustration of Quadrant Jump Test

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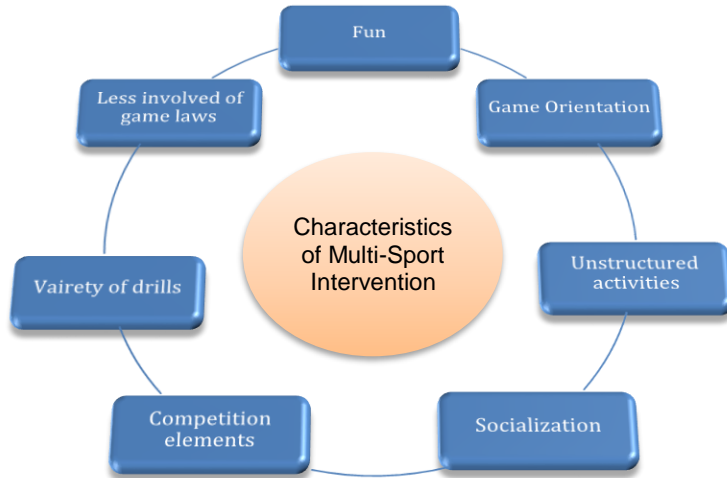


Figure 2: Characteristics of Multi-Sport Intervention

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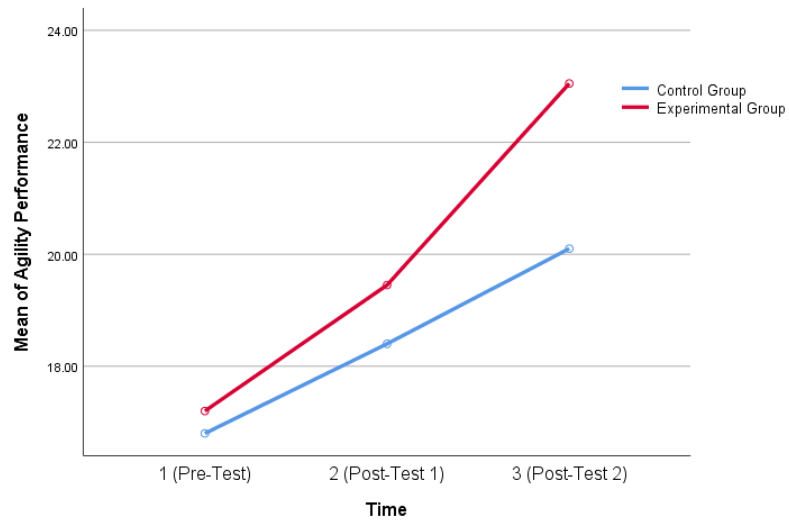


Figure 3: The mean of agility performance between groups and time