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**Speed and Agility Training in Female Soccer Players – A Systematic Review**

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## Abstract

Female soccer players performs between 1350-1650 activity changes, along with jumping, accelerating and decelerating. The ability to repeat these actions identically in competition are essential for success in female soccer. Hence, the study aim was to summarize relevant literature on the effects of speed and agility training in female soccer players. Literature identification were conducted according to the PRISMA guidelines and in multiple databases (Google Scholar, PubMed, Scopus, Cochrane Library, ProQuest, EBSCOhost and Science Direct). Based on the pre-defined inclusion criteria (year of publication (2003-2022), full-text study published in English, the experimental study that had included healthy and injury-free female soccer players as participant sample) database search have identified 23502 potential studies. In the end, a total of six full-text studies were included, with a total of 141 female participants. There were a variety of experimental programs, such as resisted, assisted and traditional sprint training, speed and agility trainings, repeated agility and strength group, along with their comparation with strength training group. Likewise, different types of duration, intensity and frequency were observed and resulted overall speed and agility improvements in female soccer players. Authors can conclude that only with well prepared and organized program, especially in pre-season, female soccer players should be able to improve important and specific factors, in order to achieve desired aim and result in terms of speed and agility.

## Introduction

Women’s soccer has advanced significantly in terms of play, finance and media in recent years and as a result, the demands for women’s soccer as team sport have risen sharply (1). Nevertheless, it’s growing popularity, female athletes are subjected to higher training volumes and competition demands than ever before, necessitating a better understanding of female athletes’ performance changes in order to design effective training programs (2). Changes in the movement mechanism of the arms or legs can influence linear action such as acceleration and velocity. Thus, the ability to develop speed quickly (acceleration) is an important component for supporting performance in a variety of sporting activities (3). Speed, agility, along with the quickness exercises cover’s the entire training intensity spectrum and it is a very small percentage that can be improved due to heredity (4). What is more, acceleration and sprint performance is associated with maturity status (5).

According to the match statistics, female soccer players covers 9-12 km during the game (6), with as much as 8-12% of that being high-intensity running or sprinting (7). The average sprint duration is between 2-4 seconds and occurs during crucial moments of the soccer game, with the vast majority of sprint displacements being less than 20 meters (8). Furthermore, female soccer players performs between 1350-1650 activity changes, including dribbling passing and tackling (9). Jumping, accelerating, decelerating, different sprints with changes of direction and the ability to repeat these actions identically in competition are essential for success in team sports like soccer (10). Moreover, mentioned explosive actions, like tackling, jumping, changing directions (COD) and sprinting, have a direct impact on the outcome of the result (11).

There are numerous studies that compare the level of speed between competition levels, age categories, as well as the relationship between reactive speed, COD speed and individual movement speed (8,10,12). Despite the research mentioned above, there is currently little scientific evidence to shows effects of speed and agility training in female soccer players (13–18). Paradis et al. (13) reported that the SAQ program improved power, speed and agility, but not strenth in young soccer players. In addition, Shalfawi et al. (15) reported significant improvements in repeated agility training and repeated sprint training in elite female soccer players, with no significant differences between groups in any of the measured variables. Furthermore, two studies (17,18) found that short sprint bouts at maximum effort had a significant effect on agility performance in adolescent female soccer players. On the other hand Shalfawi et al. (16), reported that agility and repeated sprint training had no significant effects in well-trained elite female soccer players.

To the authors knowledge, there are a few studies that have analyzed the effects of speed and agility training in female soccer players. However, no study has been conducted that summarizes the literature in women’s soccer. As a result, the purpose of this study is to summarize relevant literature on the effects of speed and agility training in female soccer players.

## Materials and Methods

**Literature Identification**

PRISMA guidelines (19,20) were used for the search and analysis of the studies. Furthermore, a multiple database identification was carried out, such as Google Scholar, PubMed, Scopus, Cochrane Library, ProQuest, EBSCOhost and Science Direct.

For study identification in mentioned databases, the multiple keywords (combination ar separately) were used: („speed enhancement“ OR „quickness“ OR „soccer speed“ OR „agility enhancement“ OR „аgility“ OR „soccer agility“ OR „SAQ“ OR „mechanical stress“ OR „physical stress“) AND („soccer“ OR „football“ OR „female soccer“ OR „female football“ „team sport“ OR „collective sport“ OR „female team sport“). The study identification and data extraction were examined separately, by a total of two authors (M.S. and D.Đ.). Then, each author had to cross-examine the identified studies, and considered if the study is eligible for further analysis or not

Furthermore, a descriptive method was used for obtained data examination, whereas all titles, abstracts and full-text articles were reviewed for eventual study inclusion in the systematic review. After detailed identification process, studies were considered to be relevant and included, only if they met the pre-defined inclusion criteria.

**Inclusion Criteria**

Each study had to meet the following inclusion criteria: year of publication (2003-2022), full-text study published in English, the experimental study that had included healthy and injury-free female soccer players as participant sample. In addition, there were no exclusion criteria in terms of years of training nor experience or rank (elite, sub elite, amateur, etc.).

**Exclusion Criteria**

The studies were not included if they have realised before 2003, published studies in other language than English, studies with male or mixed gender participants, studies where full-text possibility was unable, the studies that have included supplements usage and studies where experimental program was influenced on other parameters beside physical performance.

**Bias Risk Assessment**

The study quality and the potential risk of bias was assessed and determined by the PEDro scale (21). Assessment were caried out by two authors (D.Ð. and I.Č.), separately. The author’s concordance was calculated using k-statistics data to examine the complete text, to determine relativity and bias risk. In case of disagreement, the provided data was evaluated and finalized by a third reviewer (M.S), independently. The concordance between reviewers was k=0.93.

**Extraction Data**

The necessary information was extracted from the studies, using Cochrane Consumer and Communication Review Group’s. The main study characteristics were: first author and year of publication, age, sample size, experimental intervention program (type, duration, frequency and training duration), measured outcomes and study results.

## Results

**Study Quality**

According to Maher et al. (22), a PEDro scale points has to be awarded in order to identify the study quality. Further, if the study has gained between 0-3 points, the study will be classified with poor quality, 4-5 points with fair quality, 6-8 points with good quality and 9-10 points with excellent quality. Same authors have also stated that 8-11 points are optimal. In studies that have included in the final analysis, three studies have classified with fair quality, while rest of three studies with good quality. Table 1 presents PEDro scale total results.

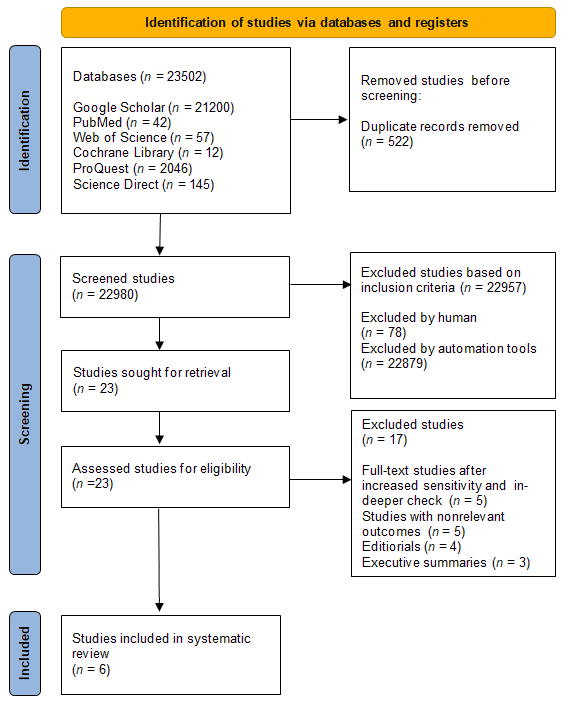
**Table 1.** PEDro scale for cross-sectional studies

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Criterion** | | | | | | | | | | | |
| **Study** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **∑** |
| Paradis et al. (2003) | Y | N | N | Y | N | N | N | Y | Y | Y | Y | 4 |
| Upton (2011) | Y | Y | Y | Y | N | N | N | Y | Y | Y | Y | 7 |
| Shalfawi et al. (2013) | Y | Y | Y | Y | N | N | N | Y | Y | Y | Y | 7 |
| Shalfawi et al. (2013) | Y | Y | Y | Y | N | N | N | Y | Y | Y | Y | 7 |
| Mathisen et al. (2014) | Y | N | N | Y | N | N | N | Y | Y | Y | Y | 5 |
| Mathisen et al. (2015) | Y | N | N | Y | N | N | N | N | Y | Y | Y | 4 |

Legend: 1—eligibility criteria; 2—random allocation; 3—concealed allocation; 4—baseline comparability; 5—blind subject; 6—blind clinician; 7—blind assessor; 8—adequate follow-up; 9—intention-to-treat analysis; 10—between-group analysis; 11—point estimates and variability; Y—criterion is satisfied; N—criterion is not satisfied; ∑—total awarded points.

**Selection and Characteristics of Studies**

Based on the database study identification, a total of 23502 were identified. At the main beginning, 522 duplicate studies were excluded, whereas a total of 22980 studies were further taken into consideration. According to the pre-defined inclusion criteria, 78 were excluded by reviewers and 22879 were excluded by automation tools, whereas 23 studies were assessed for eligibility. Additional 17 studies were excluded based on in-deeper check, non-relevant outcomes, editorials and executive summaries. In the end, 6 studies were included in the systematic review (Figure 1.)



**Figure 1.** PRISMA flow chart of study identification

Table 2 presents studies that have included in the systematic review based on pre-defined criteria.

**Table 2.** Studies that have included in the systematic review

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **First author and year of publication** | **Participants** | | **Duration**  **(weeks)** | **Program**  **(type, intensity frequency, training duration** | **Measured outcomes** | **Results** | | | |
| **Age**  **(Years)** | **Number and groups** |
| Paradis et al. (2003) | 13.07±0.59 | SA-19  C-13 | 6 | SA–speed and agility training program 2x a week  C–regular soccer training | T-test  40yd  CMJ  LJ | SA | | C | |
| T-test ↑\*  40yd ↑\*  CMJ ↑\*  LJ ↑ | | T-test ↓  40 yd ↓  CMJ ↑  LJ ↑ | |
| Upton (2011) | 19.6±0.9 | N-27  AST-8  RST-9  TST-10 | 4 | AST–supramaximal efford 20yd + 20yd deceleration to jog, 10x assisted sprint, 3min rest  RST–20yd + 20yd maximal effort sprint + 20yd deceleration to jog, 10x resisted sprint, 3min rest  TST–20yd sprint + 20yd deceleration to jog, 10x maximal efford sprint, 3min rest | 5, 15, 25, 40 yd | AST | RST | | TST |
| 5yd ↑\*  10yd ↑\*  25yd ↑\*  40yd ↑\* | 5yd ↔  10yd ↓  25yd ↑  40yd ↑\* | | 5yd ↓  10yd ↑  25yd ↑  40yd ↑ |
| Shalfawi et al. (2013) | 21.2±2.6 | RAG-8  RSG-9 | 8 | RAG–2x4 agility run, 120sec. recovery between exercises, 10min recovery between sets, Intensity=95-100% first 5 weenks, rest of 3 was 100%  RSG–2x(5-9)x40m, 90sec. recovery between exercises, 10min recovery between sets, Intensity=95-100% first 5 weeks, rest of was 100% | 40m sprint  40m agility  CMJ  RSA-10x40m  YY1 | RAG | | RSG | |
| 40m sprint ↑  40m agility ↑\*  CMJ ↑  RSA ↑\*  YY1 ↑\* | | 40m sprint ↑\*  40m agility ↑  CMJ ↑\*  RSA ↑\*  YY1 ↑\* | |
| Shalfawi et al. (2013) | 19.4±4.4 | N-20  RAG/RSG  STG | 10 | RAG–2-4 sets, 1min. recovery between exercises, 10min. recovery between sets, 100% intensity  RSG–2-5 sets of 4-5x40m, 90sec. rest between exercises, 10min. rest between sets, Intensity=95-100% first 4 weeks, rest of was 100%  STG–leg press, squat jump, nordic hamstring, leg extension, cable hip flexion and extension | SJ  CMJ  RSA-7x30m  40m sprint  40m agility  Bt | RAG/RSG | | STG | |
| SJ ↑  CMJ ↑  RSA ↓  40m sprint ↓  40m agility ↑  Bt ↑\* | | SJ ↑\*  CMJ ↑  RSA ↑  40m sprint ↓  40m agility ↓  Bt ↑\* | |
| Mathisen et al. (2014) | 13.6±0.2 | E-13  C-13 | 8 | E–32 short-burst sprints 10min warm-up, 50min short-burst running LIN or COD sprints (40-90sec. rest) (once a week in addition to 2 regular trainings) per week  C–regular soccer training | 10m sprint  20m sprint  Agility | E | | C | |
| 10m sprint ↑\*  20m sprint ↑\*  Agility ↑\* | | 10m sprint ↔  20m sprint ↑  Agility ↓ | |
| Mathisen et al. (2015) | 15.5±0.7 | E-10  C-9 | 8 | E–32 short-burst sprints 10min warm up, 45 min short-burst running LIN or COD sprints (60-90sec. rest) (once a week in addition to 2 regular trainings) per week  C–regular soccer training | 10m sprint  20m sprint  Agility | E | | C | |
| 10m sprint ↑\*  20m sprint ↑\*  Agility ↑\* | | 10m sprint ↔  20m sprint ↑  Agility ↓ | |

N–total number of participants, E–experimental group, C–control group, SA–speed and agility, yd–yards, T-test–agility T-test, CMJ–countermovement jump, SJ–squat jump, LJ–long jump, RST–resisted sprint training, AST–assisted sprint training, TST–traditional sprint training, RAG–repeated agility group, RSG–repeated sprint group, STG–strength training group, RSA–repeated sprint ability, COD–change of direction, LIN–linear sprint, YY1–Yo-Yo IR1 test, Bt–Beep test

There were a total of 141 female participants. The youngest participant was 13 years old (17), while the oldest was 21 years old (15). A total of 2 studies have presented 3 groups only (without control group) (14–16) and 3 studies have presented one experimental and one control group (13,17,18). Experimental program duration variated from 4-10 weeks, whereas variables variated from running speed in all studies, RSA (15,16) agility (15–18) and explosive strength (13,15,16). Only one study have had examining the influence on the YoYo IR1 test (15).

There were a variety of experimental programs, such as resisted, assisted and traditional sprint training (14), speed and agility trainings (13), repeated agility and strength group (15), along with their comparation with strength training group (16).

## Discussion

The study aim was to summarize relevant literature on the effects of speed and agility training in female soccer players. The main study findings are 6 studies that have presented various types of speed and agility training, with different types of duration, intensity and frequency, that have resulted overall speed and agility improvements in female soccer players.

Increased step frequency and reduced ground contact time have a positive effect on maximum speed as well as the result of reduced acceleration time (13,23). Kyröläinen, Avela & Komi (24) have found that during the acceleration phase of sprinting, maximal integrated electromyographic (EMG) activity is greater than during the constant velocity period, indicating that this is the moment when the sprinter’s neural activation is greatest. A significant increase in muscle force development in initial acceleration in the AST group occurred in the first 5 yards (4.6m) of the sprint, while the RST group had the greatest increase in speed during the 15 to 25 yards (13.7 to 22.9m), and as it was hypothesized acceleration increased significantly (p<0.001) over a 4 week period (14). Repeated linear sprint training improves intermittent running ability more than agility training, while repeated agility training improves specific agility improvement and both groups on the RSA test (10x40m) with 95% maximum running speed finished with 97% in the post-test (15). This indicates the ability to achieve repeated sprints close to maximal intensity and similar results were also applied in the study by (25).

Since it was observed only moderate improvements (d=0.8) in the RAG/RSG group, as well as trivial to negative in agility performance in the STG group (16), these results are not in accordance with Dupont et al. (26), who have observed improvements in RSA. These soccer players have performing one repeated sprint session and one aerobic training session each week, in addition to one game and 8-10 normal soccer training sessions during the season. As a result, a physical conditioning program must be carefully balanced with regular soccer training. A carefully constructed training program for one set of skills may impede the development of other vital attributes and vice versa. It is also recognized that the constant stress, along with the strength and conditioning program, can create a „chronic catabolic environment“ for the neuromuscular system. Because these studies were done in-season, this setting may result in modest or no changes in other physical characteristics (27). Hence, an additional physical fitness program must be well planned and balanced together with regular soccer training, especially during in-season period.

According to Yap & Brown (28) , female training regimens are identical to males training protocols, as women’s training programs have improved significantly over the years. Mathisen et al. (17) have resulted a significant increase (6.2%) in agility performance in a 8 week LIN and COD program, which is consistent with findings Pettersen & Mathisen (29). Although initial acceleration and short sprint are reported to be more difficult to improve than maximal speed (30), this study also shows a significant improvement in the acceleration phase (5.1%) in the 10m sprint and (3.5%) in 20m sprint. Furthermore, results from other study (18), with a bit older participants have revealed 10m straight sprint (4.1%), 20m straight sprint (3.2%) and agility performance (5.2%) improvement. Since growth and maturation could increase sprint performance (31), maturity status has a crucial role in modulating the response to speed exercises (32).

Likewise, women go through a biological process during the menstrual cycle, where hormone levels rise and fall (33). Julian et al. (34) have highlighted that there could be a performance decreases during the mid-luteal phase where hormones were contrasted in the peak phase of the menstrual cycle and this decreases was not found in jumping or sprint performance. Hence, in order to examine and analyze how the phases of the menstrual cycle affect physical performance, it is necessary to take into consideration the specificity of sport (35). But further investigation is needed, in order understand the mechanism in fully.

This study has also some limitations. First, we have taken into consideration studies that have dealth with regular speed and agility, but not reactive. Second, we did not taken into consideration the anterior cruciate ligaments (ACL) condition in the participants sample, which can be an important factor, for both speed and agility. Hence, future studies can include the mentioned medical state, for both future experimental studies and systematic reviews.

## Conclusion

Since the speed is about 95% congenital, the same can be relatively enhanced. On the other hand, agility is not congenital as speed, but it can be more influenced. Hence, only with well prepared and organized program, especially in pre-season, female soccer players should be able to improve these important and specific factors, in order to achieve desired aim and result.

## Data Availability

## Data available on request

## Conflicts of Interest

## The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Funding Statement

## The research received no external funding.

## Supplementary Materials

None.

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