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Characterization of agility level in novice beach volleyball players

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Abstract.

Beach volleyball is a team-based net sport played on an unstable surface, requiring explosive, short-duration motor actions. In this context, agility—as a physical capacity—is a key determinant of athletic performance. The objective of this study was to characterize the agility levels of beach volleyball players in the 13–15 age group (the introductory competitive category) in the province of Villa Clara, Cuba. A descriptive, cross-sectional study design was employed, involving three groups: two coaches from the School for Sports Initiation (EIDE), seven male players in this age category enrolled at the center in 2019, and 16 coaches who participated in the 2019 National School Games for High-Performance Sports, representing their respective provinces. The research was conducted in three stages: document analysis and interviews, the selection / adaptation of specific tests via expert consensus, and field-based assessment. The results indicated an average level of agility among the players. However, a significant deficit was identified in maneuvers toward the left side of the court and in anteroposterior (forward and backward) movements, with more than 40% of the players falling into the low percentile. It is concluded that there are directional asymmetries and deficiencies in longitudinal motor patterns; which should be taken into account by coaches to optimize the planning of specific training within the overall preparation of these players.

Keywords: Beach volleyball, agility, sports initiation, motor assessment.

Introduction

Beach volleyball is a team net sport characterized by its execution on an unstable surface (sand), which places high bioenergetic and neuromuscular demands on players. These demands manifest in short-duration, interval-based explosive actions (McLaren et al., 2018; Griego et al., 2019; Hunchenko et al., 2021; Söyler, 2022). It is a game with a wide variety of actions, unpredictable environments, and specific tactical requirements. All of this necessitates developing skills in defensive actions, which involve rapid movements with changes of direction and body position (González et al., 2022).

These circumstances require coaches to plan training sessions where key physical abilities such as agility and specific endurance are increasingly tailored to the demands of the game (Dawes & Roozen, 2017; Palao et al., 2018; Echeverría et al., 2020; Palao, Manzanares, & Ortega, 2022; Jiménez et al., 2026). Furthermore, physical performance is an essential component in the development of athletic performance in this sport, especially during the formative stages of young players (Moya, Moya, & Martínez, 2026).

It is important to highlight that, in the dynamics of this discipline, agility is a fundamental physical capacity for achieving high athletic performance (Azmi & Kusnanik, 2018; Büchel et al., 2022; Marzano-Felisatti et al., 2024). In this sport, players' actions are performed on sand, for periods that can last up to 15-20 seconds, and in conditions of high heat and humidity (Giatsis, Panoutsakopoulos & Kollias, 2022; Jiménez et al., 2022). This aspect is of vital importance today, as it improves players' physical fitness and is essential for successfully withstanding the demands of competition (Andrade et al., 2020; Pavlinovic et al., 2022; Makaruk et al., 2023).

From the perspective of agility training theory, authors such as Young et al. (2002) conceptualize it based on two interrelated components: speed in changes of direction and the perceptual and cognitive factors involved in decision-making. Both dimensions are constantly manifested during play. In line with this, contemporary trends in Sports Training Theory and Methodology indicate that the loads and interventions planned in the training session must strictly correspond to the biological and technical-tactical demands of competition (García-de-Alcaraz, et al., 2024).

According to authors like Griego et al. (2019), agility is a capacity that allows a player to move quickly and fluidly on the court. It involves the ability to accelerate and decelerate the body rapidly and in conjunction with game actions. From this, it can be deduced that, to achieve optimal competitive performance, a player must master a repertoire of stereotyped and flexible motor patterns to execute precise actions, perfected through contextualized practice. Several authors have addressed this topic in beach volleyball, analyzing the difference between the speed of simple changes of direction and reactive agility in relation to decision-making in beach volleyball players. This approach evaluates how core stability and the unstable surface affect players' reaction times (Pita et al., 2023; Medeiros, Marcelino, and Mesquita, 2023).

In beach volleyball, from the initial stages of training, the sports development process should focus on specific and decisive performance aspects if the goal is to achieve maximum competitive results more quickly and effectively. Therefore, it is essential that coaching staff have reference points and values to accurately develop agility training. However, within the context of school-based sports initiation in Cuba (ages 13-15), there is a substantial lack of knowledge regarding the values that characterize the agility level of beach volleyball players (González, et al., 2022).

Furthermore, existing scientific literature focuses predominantly on elite players. Additionally, previous research indicates a marked tendency among coaches to extrapolate diagnostic tests from indoor volleyball, ignoring the biomechanical and bioenergetic characteristics of beach volleyball (Griego et al., 2019; Griego et al., 2022). Considering the arguments presented above, the objective of this research was to characterize the level of agility present in school-aged beach volleyball players in

the province of Villa Clara, through the application of a protocol of specific tests adapted to the discipline.

Materials and methods

For the development of this research, a descriptive, cross-sectional field study was conducted, based on an analysis of the dynamics of the game. A non-experimental design was used, as there was no attempt to manipulate the variables under study; instead, events were simply described as they occurred, and subsequently analyzed (Hernández, Fernández, and Baptista, 2010).

Context and participants. The research involved three populations:

- **Population 1:** Beach Volleyball Coaches from the "Héctor Ruiz" School of Sports Initiation (EIDE) in Villa Clara (n = 2).
- **Population 2:** Beach Volleyball coaches participating in the 2019 National High Performance School Games (JENAR) (n = 16).
- **Population 3:** Sample of male players from the 13-15 year old school category of the EIDE provincial of Villa Clara (n = 7; age: 14.0 ± 0.8 years).

The methods used in the research were: document review, structured interview, brainstorming, and measurement.

Stages for the development of the study

Methodology. The present research was structured in three sequential methodological phases:

Phase 1 (Diagnostic analysis and test selection): Scientific articles on agility in beach volleyball—such as those by González et al. (2022) were reviewed, as they were official sports policy documents in Cuba, including Training plans, doctoral and master's theses, and the Comprehensive Athlete Preparation Program (PIPD) were also examined. Structured interviews were conducted with the two coaches from the EIDE (School for Sports Initiation) to explore their understanding of agility training

Subsequently, within the framework of the 2019 National Sports Games (JENAR), two methodological workshops were held with the 16 coaches to unify conceptual criteria and determine how to evaluate the level of agility in beach volleyball players at the introductory level. All provinces of the country were represented in the group workshops.

All the coaches held degrees in Physical Education and worked in their provinces with players in the school age group (13-15 years old). The coaches' ages ranged from 24 to 45 years, they had between 12 and 30 years of experience, and 80% were men and 20% were women. The concept of agility adopted in the workshops was that defined by Griego et al. (2019): the player's ability to move quickly and fluidly on the court, which implies the ability to accelerate and decelerate the body rapidly and in conjunction with game actions.

It is important to note that these workshops were led by the lead author of this research. The first workshop focused on clarifying the concept of agility, specifically as it relates to beach volleyball, and how this ability is addressed in the sport's regulatory documents. In the second workshop, the 16 coaches worked together to define and select, by consensus, a method for evaluating agility levels in beach volleyball players. Several research proposals and tests for measuring this ability were presented. The main criterion for evaluating these tests was that they had to be previously validated through scientific research. Using a brainstorming technique during the workshop, six potential tests were identified; through participant consensus, this number was narrowed down to three. This selection was reached by consensus, as the coaches deemed these three the most appropriate for assessing the agility levels of beginner beach volleyball players. Consequently, it was decided to implement the protocol proposed by González et al. (2022).

Phase 2 (Field Evaluation): Subsequently, as part of the research project, using a measurement-based method, the three selected tests were applied to the seven male players on the sand court of the EIDE provincial school in Villa Clara, standardizing the measurement conditions.

Standardized conditions for conducting the tests (González et al., 2022):

- The tests will always be performed after a warm-up.
- The exercise should never be performed after training.
- The player must have a normal pulse and respiratory rate before performing the test.

The tests always followed the same application sequence, with a five-minute rest interval between each one. The assessments were developed in a single day and at the usual training location, between 9:00 am and 11:00 am. Participants were instructed beforehand to avoid eating heavy meals for at least two hours prior to the testing and to ensure they were adequately hydrated.

At their arrival, the players received a detailed explanation of the procedures. Subsequently, a standardized 10-minute dynamic warm-up, designed by the researchers, was performed, which included general and specific mobility exercises on the sand. Finally, the different tests were administered following the protocol proposed by González et al. (2022).

Phase 3 (Statistical processing and analysis): The collected data were processed using descriptive statistics (mean, median, and ranges) due to the absence of national benchmarks for the beginner category. Since the results were derived from test and retest values procedures, the Wilcoxon signed-rank test (a non-parametric test) was used to establish performance percentiles—25th percentile (high level), 50th percentile (medium level), and 75th percentile (low level)—expressed in terms of execution time in seconds.

Results

In Phase 1, A document review of the PIPD revealed a limited specific methodological guidance regarding the agility training. Interviews indicated a lack of precision in how the coaches operationally defined agility, as well as an absence of reference values for the introductory categories. The three diagnostic tests selected for the field assessment (González et al., 2022) of the players were:

- Test 1 (P1): Three lateral contacts (variants: short and long movements).
- Test 2 (P2): Three forward zig-zag contacts (variants: short and long movements).
- Test 3 (P3): Three contacts along an anteroposterior path (forward and backward).

For Test 3, given the need to assess the reliability of the results obtained, two repetitions per subject were performed instead of the single repetition originally proposed in the protocol—a point that had been discussed during the second methodological workshop. Table 1 below presents the results obtained from Test 1. A main trend observed in these results is a functional asymmetry, characterized by longer execution times when moving toward the left side compared to the right side.

Table 1. Execution times (seconds) in Test 1 .(González et al., 2022).

Subject (#)	Age	Short Lateral Displacement			Long Lateral Displacement		
		RI (s)	RD (s)	RP (s)	RI (s)	RD (s)	RP (s)
1	15	5.11	4.53	4.82	6.16	5.79	5.97
2	14	4.84	4.99	4.91	5.90	6.02	5.96
3	14	4.89	4.63	4.76	6.04	5.86	5.95
4	14	4.90	4.95	4.92	6.04	6.11	6.07
5	15	4.95	5.02	4.98	6.08	6.12	6.10
6	13	5.25	5.20	5.22	6.80	6.74	6.77
7	13	5.40	5.48	5.44	7.16	6.98	7.07
Average		5.05	4.97	5.01	6.31	6.23	6.27

Legend: RI = Left profile result; RD = Right profile result; RP = Individual average result.

As a result of the application of Test 2 (Table 2), the data obtained also confirm the trend described above: Zig-zag displacements that involve turns or supports to the left register greater temporal latency.

Table 2. Execution times (seconds) in Test 2. (González et al., 2022).

Subject (#)	Age	Short Zigzag to the Front			Long Zigzag to the Front		
		RI (s)	RD (s)	RP (s)	RI (s)	RD (s)	RP (s)
1	15	4.42	3.75	4.08	6.13	5.63	5.88
2	14	4.05	3.95	4.00	6.32	5.81	6.06
3	14	4.00	4.14	4.07	6.09	5.70	5.89
4	14	4.15	4.19	4.17	6.25	6.15	6.2
5	15	3.95	4.02	3.98	6.08	6.00	6.04
6	13	4.10	4.05	4.08	6.43	6.40	6.41
7	13	5.50	5.39	5.44	6.73	6.90	6.81
Average		4.31	4.21	4.26	6.29	6.08	6.28

Legend:RI = Left profile result; RD = Right profile result; RP = Individual average result.

The results of Test 3 are presented in Table 3. As can be seen, the data reflects anteroposterior displacements. This test revealed a marked technical difficulty in decelerating and re-accelerating along the longitudinal axis.

Table 3. Execution times (seconds) in Test 3. (González et al., 2022).

Subjects (#)	Age	Repetition 1 (R1)	Repetition 2 (R2)	Average Result (RP)
1	15	5.41	4.65	5.03
2	14	5.06	4.47	4.76
3	14	4.41	4.83	4.62
4	14	4.92	5.01	4.96
5	15	4.98	4.99	4.98
6	13	5.25	5.90	5.57
7	13	5.40	6.29	5.84
Average		5.06	5.16	5.11

Test 3 shows high variability in results among players. The previously mentioned difficulty in decelerating and re-accelerating along the longitudinal axis is reflected more in the dispersion than in a systematic change between R1 and R2. Some subjects perform worsen in the second repetition, which could indicate fatigue or a lack of technical control; others improve, which could reflect learning.

Paired repeated measures t-tests were performed, since each subject went through all conditions. With $n = 7$, these results (Table 4) are exploratory; therefore, they should have been supplemented with non-parametric Wilcoxon tests.

Table 4. Results of paired repeated measures t-tests

Comparison	Difference mean $\pm$ SD	t(6)	p approx.	Cohen's d
P1 long – short RI	1.26 $\pm$ 0.28	12.05	< .001	4.55
P1 long – short RD	1.26 $\pm$ 0.19	17.19	< .001	6.50
P1 long – short RP	1.26 $\pm$ 0.23	14.62	< .001	5.52
P1 short RI – RD	0.08 $\pm$ 0.26	0.79	.46	0.30

P1 long RI – RD	0.08 ± 0.17	1.22	.27	0.46
P2 long – short RI	1.98 ± 0.39	13.59	< .001	5.14
P2 long – short RD	1.87 ± 0.28	17.57	< .001	6.64
P2 long – short RP	1.92 ± 0.30	16.88	< .001	6.38
P2 short RI – RD	0.10 ± 0.27	0.96	.38	0.36
P2 long RI – RD	0.21 ± 0.26	2.08	.083	0.78
P3 R2 – R1	0.10 ± 0.61	0.44	.68	0.17

These results show that the effect of displacement length is very large and consistent across P1 and P2 ($p < .001$, $d > 4$). Furthermore, left-right asymmetries are small and non-significant—with the exception of a marginal trend in the "long zig-zag" condition ($p \approx .083$)—and there is no significant difference between repetitions in P3. The paired t-tests were supplemented with the non-parametric Wilcoxon signed-rank test for related samples, which is suitable for $n = 7$ and for variables that may not meet the assumption of normality. A correction for tied ranks (using the average of the ranks) was applied, and the exact two-tailed p-value was calculated by enumerating all 2^n possible sign assignments (in the absence of ties) or by using the distribution conditioned on the observed ranks (when ties are present).

Table 5. Results of the expanded exploratory inferential analysis with non-parametric Wilcoxon tests.

Comparison	Mean difference ± SD	t(6)t(6)	pp t	W+W	W-W	Wilcoxon	rrbrr b
P1 long – short RI	1.26 ± 0.28	12.05	< .001	28	0	.0156	1.00
P1 long - short RD	1.26 ± 0.19	17.19	< .001	28	0	.0156	1.00
P1 long - short RP	1.26 ± 0.23	14.62	< .001	28	0	.0156	1.00
P1 short RI – RD	0.08 ± 0.26	0.79	.46	14.5	13.5	.969	0.04
P1 long RI – RD	0.08 ± 0.17	1.22	.27	20	8	.344	0.43
P2 long – short RI	1.98 ± 0.39	13.59	< .001	28	0	.0156	1.00
P2 long – short RD	1.87 ± 0.28	17.57	< .001	28	0	.0156	1.00
P2 long - short RP	1.92 ± 0.30	16.88	< .001	28	0	.0156	1.00
P2 short RI – RD	0.10 ± 0.27	0.96	.38	18	10	.578	0.29

P2long RI – RD	0.21 ± 0.26	2.08	.083	24	4	.109	0.71
P3R2 – R1	0.10 ± 0.61	0.44	.68	18	10	.578	0.29

Symbolism: W+W+ (sum of positive ranks). W-W- (sum of negative ranks). Rank-biserial correlation

$$r_{rb} = (W+ - W-) / (W++W-) \quad r_{rb} = (W+ - W-) / (W++W-).$$

The results of the Wilcoxon test show that:

- *Effect of displacement length:* In P1 and P2, all long-short differences were positive (long times were always greater). Wilcoxon yielded $p = .0156$ in all cases, which is the minimum possible value with $n = 7$ when all differences are in the same direction. This non-parametrically confirms the strong effect of distance.
- *Left-right asymmetry:* The RI-RD comparisons did not reach statistical significance. In short P1, long P1, and short P2, the p-values were high (.969, .344, and .578, respectively). Only in long P2 was a marginal trend observed between RI and RD ($p = .109$, $rb = 0.71$), consistent with the t-test ($p = .083$). Therefore, the evidence for greater latency toward the left side remains weak.
- *Test 3 (R2 – R1):* No significant difference was observed between repetitions ($p = .578$, $r_{rb} = 0.29$). This supports the conclusion that there is no systematic learning or fatigue effect between R1 and R2, although high individual variability persists.
- *Limitation by $n = 7$:* With such a small sample size, very large effects (such as long vs. short) cannot produce $p < .001$ in the non-parametric test, even though the t-test does. This reinforces the need to increase the sample size.

Since no data were available for this level, the normative stratification of agility in this test was established, and the evaluation percentiles were set (Table 6). The categories for measuring the performance level were defined as follows:

- High Level (P25),
- Intermediate Level (P50).
- Low Level (P75).

Table 6. Norms for normative percentiles (in seconds) for the assessment of agility in the sample.

Percentile / Level	Short Zig-zag (s)	Long Zig-zag (s)	Short Lateral (s)	Long Side (s)	Antero-lateral (s)
P25 (High Level)	4.00	5.89	4.82	5.95	4.76
P50 (Intermediate Level)	4.08	6.06	4.92	6.07	4.98
P75 (Low Level)	5.44	6.41	5.22	6.77	5.57

Once the values indicating the players' level, according to their percentile, were established, the general trend of the players' agility level was obtained. This allowed for the determination of the group's overall trend.

By classifying the players according to the standardized percentile norm as shown in Table 5, it was identified that the average performance level predominates in zigzag movements (42-57%). In long lateral and anteroposterior movements, the results show a higher proportion of players at the low level (42.8%).

Table 7. Percentage distribution of players according to performance level by percentile.

Evaluated Test	High Level(P25) n (%)	Intermediate level(P50) n (%)	Low Level(P75) n (%)
Short lateral zigzag	2(28.6%)	3(42.8%)	2(28.6%)
long lateral zigzag	2(28.6%)	4(57.2%)	1(14.2%)
Short lateral displacement	2(28.6%)	3(42.8%)	2 (28.6%)
Long lateral displacement	2(28.6%)	2(28.6%)	3(42.8%)
Front-backward displacement	2(28.6%)	2(28.6%)	3(42.8%)

Discussion

The findings of this study reveal that school-aged beach volleyball players (13-15 years old) in Villa Clara province exhibit a normative agility trend at an intermediate level, as observed in the percentile results. However, the vector and multidirectional analysis reveals a deficit in movements to the left side and in anteroposterior transitions. The distance of the movement is the factor that most affects execution time. In both movement tests, longer distances significantly increase the time, suggesting that the demands on motor control, stabilization, and travel time are determining factors.

This finding creates a significant methodological contradiction with the kinematic literature on beach volleyball (Griego et al., 2019; Jiménez, 2019), which states that movements toward the left side of the court are the most frequent during the defensive and reception phases of Complex 1 (K1). Therefore, it becomes clear that if players exhibit the worst reaction times and changes of direction precisely toward the side most tactically demanded, it constitutes a disconnect between general/specific physical preparation and the actual demands of the game. This should be an important factor for coaches to consider when designing their players' training programs.

Furthermore, the marked deficiency in anteroposterior movements (42.8% at a low level) can be explained primarily by biological maturity at a given age and secondarily by the high mechanical cost imposed by the running surface (sand) on braking, deceleration, changes of direction, and subsequent propulsion (Hunchenko et al., 2021; Marzano-Felisatti et al., 2024). Therefore, it is important to note that without adequate development of the reactive-elastic strength of the hip and knee extensors, agility in longitudinal trajectories is severely impaired.

The small sample size ($n = 7$) is recognized as the main limitation of the study. However, this figure is representative of the institutional context of School Sports Initiation Programs in Cuba, where enrollment in Beach Volleyball is restricted by the sport's structure (two starting players per pair). Subjects 6 and 7, aged 13, posted the highest times in almost all tests. However, with only two 13-year-old subjects, the age effect cannot be separated from the individual effect.

Future research should expand the cohort through national multicenter studies and also include females. This will allow for better observation and assessment of the actual physical performance of agility. Therefore, these elements could be considered for future research, either through longitudinal monitoring of physical performance or by evaluating differences based on sex.

Conclusions

1. The results of this study have shown that the general state of agility in male Beach Volleyball players of the 13–15-year-old school category of the School Sports Initiation School in Villa Clara, is at a medium level with respect to the percentile standards determined.
2. A functional asymmetry was evident in directional agility, manifested in lower performance in movements to the left side of the court and in the anteroposterior trajectory, which constitutes an important element (reference values) for the planning work of the coaches.
3. Test 3 shows no significant differences between repetitions, but does show high individual variability. Therefore, the results demonstrate a clear and consistent effect of displacement length on execution time: greater length leads to greater latency, with increases of 25% in lateral displacements and 45% in zigzag displacements.
4. The results suggest the need to reorient the planning process of school sports training in Cuba, so these findings can contribute to optimizing the processes of talent detection for certain specializations and planning of training in the formative stage.

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