



A Comparative Analysis of Male and Female Complex I Skill Performance in Beach Volleyball

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Abstract

Objectives. The objective of this study was to analyse and evaluate the performance of skill types among male and female players in Complex I.

Materials and Methods. The study comprised 28 men's and 26 women's matches, representing the 32 national teams that participated in the FIVB World Tour Finals 2019. A total of 3624 Complex I sequences were recorded and assessed. Passing skills (reception and setting) were evaluated using a four-level tactical rating quality scale, while attacking hits were assessed using a five-level scale. The observer's reliability test demonstrated a high correlation coefficient.

Results. Male beach volleyball players generally exhibited higher quality (Quality Level–QL3) in serve reception and setting, as well as greater effectiveness (QL4) in attacking hits compared to women. Males used more frequently the basic forearm pass technique in reception ($p = 0.001$), the overhead set ($p = 0.001$) in setting, and the hard-driven ball ($p = 0.001$) in attacking compared to females. In contrast, females used more frequently the side forearm pass and other techniques in reception ($p = 0.001$ and $p = 0.001$, respectively), the forearm setting ($p = 0.001$), and the driven ball and poke shot techniques in attacking ($p = 0.001$ and $p = 0.001$, respectively). Furthermore, the higher the quality of serve reception, the better the quality of the setting ($p < 0.001$), and the higher the quality of the setting, the more effective the attack ($p < 0.001$) for both genders. Finally, the results showed that male athletes executed excellent settings more frequently than female athletes ($p = 0.02$, $p = 0.001$, and $p = 0.001$, respectively), regardless of the quality level of the received serve.

Conclusions. Male players were more effective than female players, as they primarily used the frontal reception technique, overhead setting, and powerful attacking hits, which enhanced the overall quality of their game. To generalize these findings, further research is recommended at different competitive and age levels.

Keywords: performance, technical skills, complex I, beach volleyball, gender.

Introduction

Beach volleyball (BV) is a popular and continuously evolving sport that attracts athletes of all ages from around the world. The nature of the sport requires a combination of exceptional physiological abilities, technical skills, and tactical intelligence. These demands make BV a sport that

requires high specialization and adaptation to the unique conditions of sand and the often-challenging outdoor environment (Casanova, 2015).

One of the most important factors affecting performance in the sport is the physiological characteristics of male and female athletes. These include anthropometric characteristics such as height, weight, and body composition, as well as cardiorespiratory variables such as heart rate and maximal oxygen consumption (VO_2 max). Particularly important is the additional burden of movement on the sand, which, as an unstable and variable surface, requires greater energy expenditure compared to hard surfaces. According to existing literature, walking is 1.8–2.7 times more energy-demanding on sand than on a

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hard surface, running is 1.2–1.6 times more costly, and jumping is 1.2 times more demanding on a sandy surface (Hank et al., 2016; Kumar, 2015; Pinnington & Dawson, 2001). These findings indicate that BV requires high levels of endurance and physical fitness from athletes, regardless of their gender.

When it comes to anthropometric characteristics, body height particularly plays a crucial role in jump performance and overall BV performance. Athletes aim to reach as high as possible to surpass the net height, allowing for better offensive (attacks) and defensive actions (blocks) to gain points and ultimately win the set and match. A study by Palao et al. (2008) that analyzed male and female BV athletes from World Tour events and the Olympic Games (2000–2006), found that male players had an average height of 193 cm, weight of 88–89 kg, body mass index (BMI) of 23.8–24.1, and an average age of 29–31 years. Female players had an average height of 177–179 cm, weight of 66–68 kg, BMI of 19.2–21.1, and average age of 27–29 years. Specialization-wise, blockers were found to be taller than defenders, while teams without specialized roles had intermediate values (Palao et al., 2008). Freire et al. (2023) further found that BV athletes were slightly shorter, lighter, and had lower fat mass than indoor volleyball players.

According to Tilp et al. (2006) volleyball and BV are characterized by six fundamental technical skills: serving, serve reception, setting (pass to the attacker), attacking (spiking), blocking, and defense. These skills are categorized into scoring skills (e.g., attacking, serving, blocking) that can directly earn points and transition skills (e.g., reception, setting, defense) that do not directly earn points. Medeiros et al. (2017) studied BV skills in relation to team performance and found that the game has a hierarchical structure, divided into attack after reception and attack after defense. They also distinguished volleyball gameplay into defensive and offensive phases, where each phase consists of 3–4 successive technical actions. Similarly, Eom & Schutz (1992) defined Complex I as serve reception, setting, and attack after reception, and Complex II as serve, block, defense, setting, and attack after defense. These sequences involve chained skills that influence one another. From this, it follows that performance in volleyball and BV cannot be assessed solely through the effectiveness of individual skills but rather holistically through all six skills to serve as a reliable performance criterion for researchers and coaches.

This study hypothesized significant performance differences between genders, with male teams showing higher effectiveness in serve reception, setting quality, and attack efficacy due to physiological factors. Also, greater skill variation within female teams and a strong dependence on the quality of each Complex I component for both genders were expected.

The purpose of this study was to analyze and evaluate the performance of male and female skill types in Complex I among the top 32 national teams participating in the FIVB Beach Volleyball World Tour Finals 2019, held in Rome in September 2019.

Materials and Methods

Study Participants

The research sample consisted of 28 matches from the top 32 men's and 26 women's national teams that participated in

the finals of the Beach Volleyball World Championship, held in Rome in September 2019 (FIVB World Tour Finals 2019). A total of $N = 3624$ Complex I sequences were recorded and evaluated.

Study Organization

To carry out the study, data was collected using the observation method and a Microsoft Office Excel spreadsheet, through which an observation protocol was created, containing the following variables (in the parentheses the categories of each variable): gender (Male, Female); reception type (Basic forearm pass, Side forearm pass, Tomahawk, Other, such as with a dive, kneeling, one-handed reception); setting type (Overhead, Forearm); and attack type [the hard-driven ball, the driven ball (slow deep placement shot), the roll shot (rotational close-range placement shot), and the poke shot (placement hit using the knuckles)].

The evaluation criteria for the non-scoring skills of reception and setting consisted of four quality levels (QL) based on Coleman et al. (1969). Regarding reception, the levels were: incorrect reception execution (QL0, missed point), poor-quality reception (QL1), moderate-quality reception (QL2), and excellent reception (QL3). Regarding the setting, they were incorrect technique/error (QL0, missed point), poor quality setting (QL1, not pinned), moderate/ good quality setting (QL2, attack manifestation) and excellent setting (QL3, attack with good conditions). The evaluation criteria for the scoring skill of attack consisted of 5 levels which according to (Eom & Schutz, 1992b) were: incorrect attack (QL0), poor execution of attack (QL1), moderate execution of attack (QL2), very good attack (QL3, the ball is returned under favourable conditions by the opponent for counterattack) and excellent attack (QL4, point).

Data Collection

Data collection was conducted using observation. Specifically, the researcher observed 54 matches, gathering data related to Complex I, as well as their respective types. The procedure followed to ensure the researcher's reliability was a test-retest, which was performed within a 15-day interval, on 10% of the games (6 matches, 3 from each gender), meeting the minimum value recommended in the literature (Tabachnick et al., 2019). This procedure was designed to control negative influences that may have arisen as a consequence of the researcher's memory. The researcher's intra-observer reliability was assessed using Cohen's Kappa index (Cohen, 1988), which showed values of $> .85$, indicating a high reliability (Altman, 1991).

Statistical Analysis

Initially, a descriptive analysis of the variables was conducted, to calculate the frequencies of each study variable. The statistical analysis used included a chi-square (χ^2) test of independence between the variables "type per skill" and "performance," which was performed using the chi-square test and Fisher's exact test when the expected count per cell was less than 5. The same procedure was followed for the remaining variables. For the comparison of proportions and frequencies, the z-test was used. To examine the relationship between the quality of the previous and the next game

action (reception-setting and setting-attack) a chi-square (χ^2) test of independence was employed. Cramer's V was calculated to quantify the effect size, with values of 0.1, 0.2, 0.4, 0.6, 0.8 and 1 representing negligible, weak, moderate, relatively strong, strong and very strong association, respectively (Kortlik & Williams, 2003). Two-way contingency tables were visualised using mosaic plots to examine the combinations of variable categories that contributed most to the association after rejecting the null hypothesis of independence. In these plots, the width and height of the tiles represent the relative frequencies of the variables being studied. Color coding and tile edges indicate each cell's standardised residual's absolute size and sign. Additionally, fixed cutoffs of ± 2 and ± 4 were used to shade cells that were individually significant at approximately $\alpha = 0.05$ and $\alpha = 0.001$ levels, respectively. The analyses of two-way contingency tables were performed using the R statistical software, with the vcd package (Meyer et al., 2020; Zeileis et al., 2007) utilised. The statistical analysis was performed using SPSS v.25 and Statgraphics v.5.1 (the latter was used for percentage testing as SPSS was not as descriptive in this regard). The significance level for all measurements was set at $p < 0.05$.

Results

The performance of serve reception in BV regarding its type, as well as its comparison between genders

A total of 3.624 reception actions were recorded. Of these, 1.798 were performed by men and 1.826 by women Table 1. The recorded types of reception were the basic forearm pass, the side forearm pass, the Tomahawk technique, and any other technique (such as with a dive, kneeling, or one-handed reception).

In general, the comparison of ratios and frequencies regarding reception performance revealed significant differences between genders. Men were of higher quality (QL3) compared to women ($z = 9.52, p = 0.001$) and performed more frequent moderate reception actions (QL1) ($z = 4.05, p = 0.001$), while women performed more frequent good receptions (QL2) ($z = -12.6, p = 0.001$) (Table 1). From the comparison of ratios and frequencies, the results showed that male beach volleyball players more frequently used the basic forearm pass technique compared to female players ($z = 13.3, p = 0.001$), while female players more frequently used the side forearm pass and other techniques ($z = -4.18, p = 0.001$ and $z = -14.7, p = 0.001$, respectively). The Tomahawk technique was rarely used by the players (Figure 1).

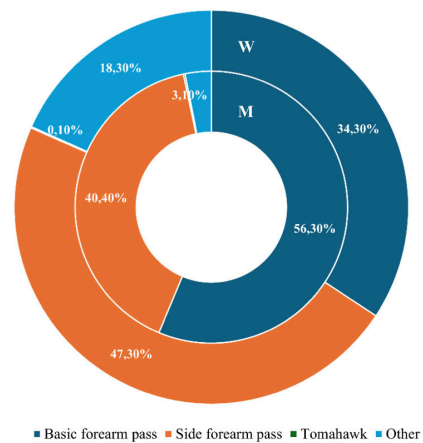


Fig. 1. Percentages of reception type occurrences by gender in BV performance

Table 1. The performance of the reception of men and women by type of reception in BV

Reception type	Gender	Reception Performance				Total	χ^2 Value Sig.
		QL0 %(N)	QL1 %(N)	QL2 %(N)	QL3 %(N)		
Basic forearm pass	M	1.1(11)	6.1(62)	18.1(183)	74.7(756)	1012	51.184
	F	3.2(20)	2.6(16)	30.3(190)	64(401)	627	0.001
	z	-3.02	3.23	-5.72	4.62		
	p	0.002	0.001	0.001	0.001		
Side forearm pass	M	5.1(37)	10.5(76)	30.6(222)	53.9(391)	726	57.999
	F	2.3(20)	4.4(38)	46.5(401)	46.8(404)	863	0.001
	z	2.99	4.69	-6.47	2.82		
	p	0.003	0.001	0.001	0.005		
Tomahawk	M	75(3)	0.0(0)	0.0(0)	25.1(1)	4	5.000
	F	0.0(0)	0.0(0)	100(1)	0.0(0)	1	0.082
	z	-	-	-	-		
	p	ns	ns	ns	ns		
Other	M	66.1(37)	12.5(7)	10.7(6)	10.7(6)	56	100.36
	F	11(37)	9.9(33)	55.5(186)	23.6(79)	335	0.001
	z	9.75	0.59	-6.21	-2.17		
	p	0.001	ns	0.001	0.03		
Total	M	4.9(88)	8.1(145)	22.9(411)	64.1(1154)	1798	164.08
	F	4.2(77)	4.8(87)	42.6(778)	48.4(884)	1826	0.001
	z	1.01	4.05	-12.6	9.52		
	p	ns	0.001	0.001	0.001		

Table 2. The performance of setting in BV, according to its type by gender

Setting type	Gender	Setting Performance				Total	χ^2 Value Sig.
		QL0	QL1	QL2	QL3		
		%(N)	%(N)	%(N)	%(N)		
Overhead	M	0.8(8)	0.9(9)	7.2(72)	91.1(908)	997	2.084
	F	1.1(4)	0.3(1)	6.2(22)	92.4(326)	353	0.555
	z	-0.52	1.13	0.64	-0.75		
	p	ns	ns	ns	ns		
Forearm	M	1.4(8)	2.6(15)	18.1(104)	78(449)	576	14.027
	F	1.2(15)	3(37)	25.9(317)	69.9(857)	1226	0.003
	z	0.35	-0.47	-3.65	3.59		
	p	ns	0.05	0.001	0.001		
Total	M	1.0(16)	1.5(24)	11.2(176)	86.3(1357)	1573	66.917
	F	1.2(19)	2.4(38)	21.5(339)	74.9(1183)	1579	0.001
	z	-0.54	-1.83	-7.82	8.09		
	p	ns	ns	0.001	0.001		

Regarding the performance of reception by type, the results showed that men were more efficient (QL3) in the types of forearms and side forearm reception ($z = 4.62$, $p = 0.001$ and $z = 2.82$, $p = 0.005$, respectively), while women performed better in the other techniques ($z = -2.17$, $p = 0.03$). Additionally, women displayed QL2 more frequently than men in all types of reception, excluding the tomahawk technique. Specifically, women showed QL2 more frequently in the basic forearm pass, side forearm pass, and other techniques ($z = -5.72$, $p = 0.001$, $z = -6.47$, $p = 0.001$ and $z = -6.21$, $p = 0.001$, respectively). On the other hand, men exhibited QL1 more frequently in the basic forearm pass and side forearm pass techniques ($z = 3.23$, $p = 0.001$, $z = 4.69$, $p = 0.001$, respectively). Finally, it was found that men made more errors when using the side forearm pass and other techniques ($z = 2.99$, $p = 0.003$, $z = 9.75$, $p = 0.001$, respectively), while women made more errors when using the Basic forearm pass ($z = -3.02$, $p = 0.002$).

The performance of setting in BV concerning its type and gender comparison

A total of 3.152 setting actions were recorded ($M = 1.573$ and $W = 1.579$) (Table 2). The types of setting recorded were overhead ($M: N = 997$ and $W: N = 353$) and forearm ($M: N = 576$ and $W: N = 1226$). The highest frequency and the highest percentages for both genders were seen in QL3, that is, in excellent settings regardless of their type. Specifically, for the overhead technique: for men ($N = 908$) it was 91.1%, and for women ($N = 326$) it was 92.4%. Similarly, for the forearm technique: for men ($N = 449$) it was 78%, and for women ($N = 857$) it was 69.9%.

In general, the comparison of the ratios and frequencies regarding the performance of setting, by setting type revealed significant differences between the genders. Men were more proficient in their passes (QL3) compared to women ($z = 8.09$, $p = 0.001$), while women more frequently performed good (QL2) passes ($z = -7.82$, $p = 0.001$) (Table 2). Additionally, it was found that male BV players used the overhead technique more often than female players ($z = 23.2$, $p = 0.001$), who, in turn, used the forearm technique more frequently ($z = -23.2$, $p = 0.001$).

Regarding the performance of setting by type, the results showed that there were no significant differences between genders in the overhead technique. However, differences were found in the forearm technique, where men were of higher quality (QL3) ($z = 3.59$, $p = 0.001$), while women were more frequently in QL2 ($z = -3.65$, $p = 0.001$).

The performance of setting in BV regarding the quality of the serve reception and the comparison between genders

A total of 3.151 setting actions were recorded ($M = 1.571$ and $F = 1.580$) (Table 3). The serve reception quality percentages, based on which settings were performed, were as follows: for men, 5.4% for QL1, 24.4% for QL2, and 70.2% for QL3, while for women, 2.7% for QL1, 45.1% for QL2, and 52.3% for QL3. A comparison of proportions and frequencies showed that men performed their settings

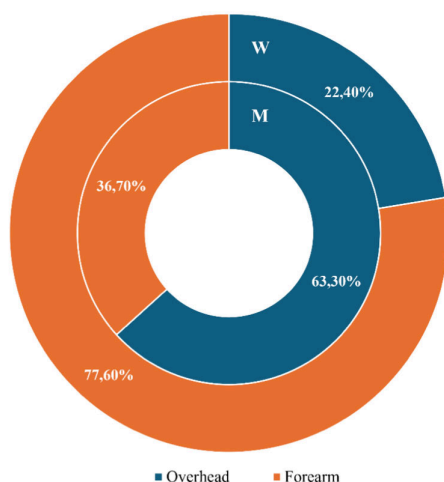


Fig. 2. Percentage of setting types by gender in BV

Table 3. The Performance of setting in BV regarding the quality of serve reception by gender

Reception Performance	Gender	Setting Performance				Total	χ^2 Value Sig.
		QL0	QL1	QL2	QL3		
		%(N)	%(N)	%(N)	%(N)		
QL1	M	8.3(7)	17.9(15)	53.6(45)	20.2(17)	84	30.045
	F	35.7(15)	40.5(17)	19(8)	4.8(2)	42	0.001
	z	-3.82	-2.75	3.65	2.28		
	p	0.001	0.006	0.001	0.02		
QL2	M	1.3(5)	1.3(5)	25.6(98)	71.8(275)	383	24.258
	F	0.3(2)	2.2(16)	38.6(275)	58.8(419)	712	0.001
	z	1.96	-1.04	-4.33	4.26		
	p	0.05	ns	0.001	0.001		
QL3	M	0.4(4)	0.4(4)	2.9(32)	96.4(1064)	1104	17.227
	F	0.2(2)	0.6(5)	6.8(56)	92.4(763)	826	0.001
	z	0.78	-0.63	-4.06	3.88		
	p	ns	ns	0.001	0.001		
Total	M	1.0(16)	1.5(24)	11.1(175)	86.3(1356)	1571	67.367
	F	1.2(19)	2.4(38)	21.5(339)	74.9(1184)	1580	0.001
	z	-0.54	-1.83	-7.9	8.09		
	p	ns	0.06	0.001	0.001		

more frequently than women after excellent (QL3) and moderate (QL1) serve receptions ($z = 10.3$, $p = 0.001$, and $z = 3.84$, $p = 0.001$, respectively). On the other hand, women performed their settings more frequently than men after good serve receptions ($z = -12.2$, $p = 0.001$). The results also indicated that regardless of gender, as serve reception performance increased, setting performance was also improved. Overall, as previously observed, men executed higher-quality settings (QL3) compared to women ($z = 8.09$, $p = 0.001$), while women more frequently performed good-quality settings (QL2) ($z = -7.9$, $p = 0.001$) (Table 3).

Independence tests revealed a significant association between the quality of reception and the quality of setting for men ($\chi^2 = 542.299$, $df = 6$, $p < 0.001$, Cramer V = 0.417, large effect) and women ($\chi^2 = 958.214$, $df = 6$, $p < 0.001$, Cramer V = 0.551, large effect). The mosaic plots in Figure 3 (left plot for men, right plot for women) reveal the structure of the relationships between the quality of reception and the

quality of setting per gender. Concerning men, standardized residuals (StRes) showed a discrepancy between observed and expected frequencies (Figure 1). These quality levels, implicated in variable interdependence, were: QL1 reception and all levels of setting (StRes = 6.6 for QL0, 12.1 for QL1, 11.7 for QL2 and -6.5 for QL3), QL2 reception and QL2 and QL3 setting (StRes = 8.5 and -3.1), QL3 reception for all levels of setting (StRes = -2.2, -3.1, -8.2 and 3.6). Concerning women standardized residuals (StRes) showed a discrepancy between observed and expected frequencies (Figure 1). These quality levels, implicated in variable interdependence, were: QL1 reception and various levels of setting (StRes = 20.4 for QL0, 15.9 for QL1, and -5.3 for QL3), QL2 reception and various levels of setting (StRes = -2.2 for QL0, 9.9 for QL2, and -5.0 for QL3), QL3 reception for all levels of setting (StRes = -2.5, -3.3, -9.1 and 5.8).

In addition, significant gender differences were identified. Regardless of the quality of the reception (QL1-3),

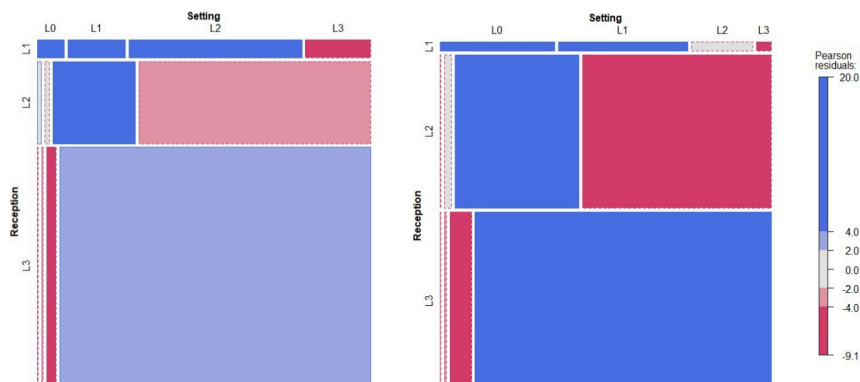


Fig. 3. Mosaic plots of men (left) and women (right)

Table 4. The performance of the attacking hits in BV concerning its type by gender

Attack type	Gender	Attacking Performance					Total	χ^2 Value Sig.
		QL0	QL1	QL2	QL3	QL4		
		%(N)	%(N)	%(N)	%(N)	%(N)		
Hard driven ball	M	19.8(195)	5.7(56)	8.8(87)	6.3(62)	59.5(587)	987	13.472
	F	16.4(91)	8.8(49)	11.4(63)	8.5(47)	54.9(304)		
	z	1.65	-2.32	-1.65	-1.61	1.75		
	p	ns	0.02	ns	ns	ns		
Driven ball	M	11.7(47)	14.9(60)	15.9(64)	5(20)	52.6(212)	403	5.738
	F	16.2(119)	16.2(119)	15.7(115)	4(29)	48(352)		
	z	-2.05	-0.57	0.09	0.79	1.48		
	p	0.04	ns	ns	ns	ns		
Roll shot	M	9.1(18)	11.7(23)	16.2(32)	5.6(11)	57.4(113)	197	0.830
	F	7.2(14)	13.8(27)	15.9(31)	5.6(11)	57.4(112)		
	z	0.69	-0.62	0.08	0.0	0.0		
	p	ns	ns	ns	ns	ns		
Poke shot	M	21.4(18)	13.1(11)	14.3(12)	6(5)	45.2(38)	84	6.517
	F	10.8(23)	18.3(39)	15.5(33)	4.7(10)	50.7(108)		
	z	2.38	-1.08	-0.26	-0.46	-0.85		
	p	0.02	ns	ns	ns	ns		
Total	M	16.6(278)	9(150)	11.7(195)	5.9(98)	56.9(950)	1671	28.080
	F	14.6(247)	13.8(234)	14.3(242)	5.7(97)	51.7(876)		
	z	1.6	-4.38	-2.24	0.25	3.03		
	p	ns	0.001	0.02	ns	0.002		

men performed excellent (QL3) settings more frequently than women ($z = 2.28, p = 0.02$; $z = 4.26$; $p = 0.001$, and $z = 3.88, p = 0.001$, respectively). Men also executed good (QL2) settings more often after a QL1 reception ($z = 3.65, p = 0.001$) and made more errors following a good (QL2) reception compared to women ($z = 1.96, p = 0.05$). On the other hand, women performed good (QL2) settings more frequently than men after good (QL2) and excellent (QL3) serve receptions ($z = -4.33, p = 0.001$ and $z = -4.06, p = 0.001$, respectively). However, they also made more errors when the reception was of good quality (QL1) ($z = -3.82, p = 0.001$).

The performance of the attacking hit in BV concerning its type and the comparison between genders

A total of 3.367 attacking hits were recorded, with 1.671 performed by men and 1.696 by women (Table 4). From the comparison of ratios and frequencies between genders regarding the type of attacking type used, the results showed that men used the hard-driven ball more frequently than women ($z = 15.1, p = 0.001$), while women used the driven ball and poke shot more frequently than men ($z = -11.8, p = 0.001$ and $z = -7.52, p = 0.001$, respectively). No significant differences were found between genders in the use of the roll shot (Figure 4).

Overall, the comparison of proportions and frequencies regarding the performance of the attacking hit revealed significant differences between genders. As shown in Table 4, men demonstrated higher quality (QL4) attacks compared

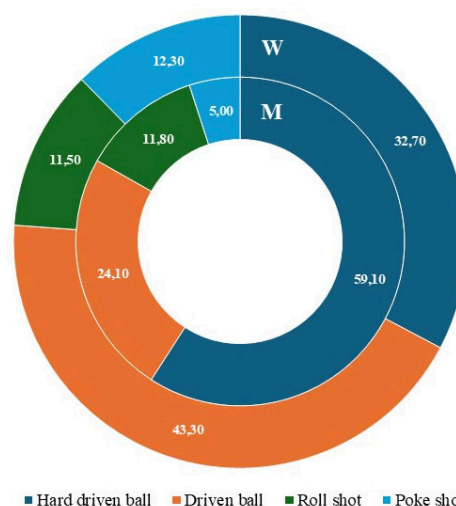


Fig. 4. Frequency percentage of attack hit types by gender in BV

to women ($z = 3.03, p = 0.002$), while women executed good (QL2) and moderate (QL1) attacking hits more frequently ($z = -2.24, p = 0.001$ and $z = -4.38, p = 0.001$, respectively).

Specifically, no differences were found between genders in good and excellent attacking actions across all types of attacking hits. However, differences were observed in moderate (QL1) and erroneous (QL0) actions. Women performed moderate (QL1) hard-driven ball attacks more

frequently than men ($z = -2.32$, $p = 0.02$) and made more errors (QL0) in driven ball attacks ($z = -2.05$, $p = 0.04$).

On the other hand, men made more errors (QL0) than women when performing poke shot-type attack hits.

The performance of the attacking hit in BV regarding the quality of the setting and the comparison between genders

Overall, as shown in Table 5, 3.093 attacking actions were recorded ($M = 1.545$ and $F = 1.548$). The frequency percentage of the quality of the setting (QL), from which the attacking hits were made, was 1.3% for QL1, 11.30% for QL2, and 87.4% for QL3 for men, while for women it was 1.6% for QL1, 21.9% for QL2, and 76.5% for QL3. From the comparison of the ratios and frequencies, it appeared that men performed attacking hits more frequently than women after excellent (QL3) settings ($z = 7.87$, $p = 0.001$), while women performed them more frequently after good (QL2) settings ($z = -7.92$, $p = 0.001$).

In general, regarding the performance of the attacking hit, the comparison of ratios and frequencies showed significant differences between genders. As shown in Table 5, men were of higher quality (QL3) compared to women ($z = 2.79$, $p = 0.005$), while women more frequently executed good (QL2) and average (QL1) attacking hits ($z = -4.07$, $p = 0.001$ and $z = -2.57$, $p = 0.01$, respectively).

Specifically, significant differences were found between genders, as men performed very good attacking hits more frequently compared to women ($z = 3.58$, $p = 0.001$) when they received good settings (QL2). However, when receiving excellent settings, men made more mistakes ($z = 3.23$, $p = 0.001$) compared to women, who more frequently performed average and good attacking hits ($z = -2.85$, $p = 0.004$ and $z = -2.29$, $p = 0.02$, respectively).

Independence tests revealed a significant association between the quality of setting and the quality of attacking for men ($\chi^2 = 70.702$, $df = 8$, $p < 0.001$, Cramer's $V = 0.151$, weak association) and women ($\chi^2 = 121.483$, $df = 8$, $p < 0.001$, Cramer's $V = 0.198$, moderate association). The mosaic plots in Figure 5 (left plot for men, right plot for women) reveal the structure of the relationships between the quality of setting and the quality of attacking per gender. Concerning men, standardized residuals (StRes) showed a discrepancy between observed and expected frequencies. These quality levels, implicated in variable interdependence, were: QL1 setting with QL1 and QP4 attack (StRes = 3.2 for QL1 and -2.5 for QL4), QL2 setting with almost all levels of attack except QL2 (StRes = 2.7 for QL0, 2.4 for QL1, 3.5 for QL3 and -4.1 for QL4). Concerning women standardised residuals (StRes) showed a discrepancy between observed and expected frequencies. These quality levels, implicated in variable interdependence, were: QL1 setting and various levels of attacking (StRes = 2.8 for QL0, 5.3 for QL1 and -3.6 for QL4), QL2 setting and various levels of attacking (StRes = 4.9 for QL0, 2.6 for QL1 and -4.1 for QL4), QL3 setting for various levels of attacking (StRes = -3.0 for QL0, -2.1 for QL1 and 2.7 for QL4).

Discussion

The present study aimed to analyze and evaluate the performance of BV players' skill types during Complex I. Additionally the goal was to identify potential gender differences. In every rally, technical skills are performed cyclically, and as has been established in indoor volleyball, each skill significantly influences the subsequent one (Bergeles et al., 2009). Specifically, in Complex I, which involves the organization of the attack, it has been observed

Table 5. The performance of the attacking hit in BV, in relation to the performance of the setting by gender

Setting Performance	Gender	Attacking Performance					Total	χ^2 Value Sig.
		QL0	QL1	QL2	QL3	QL4		
		%(N)	%(N)	%(N)	%(N)	%(N)		
QL1	M	30(6)	30(6)	20(4)	5(1)	15(3)	20	6.851
	F	36(9)	52(13)	12(3)	0.0(0)	0.0(0)	25	0.144
	z	-0.42	-1.48	0.73	-	-		
	p	ns	ns	ns	ns	ns		
QL2	M	25.1(44)	14.3(25)	14.3(25)	12.6(22)	33.7(59)	175	13.530
	F	24.8(84)	18.6(63)	16.5(56)	4.1(14)	36(122)	339	0.009
	z	0.07	-1.22	-0.65	3.58	-0.52		
	p	ns	ns	ns	0.001	ns		
QL3	M	15.6(210)	7.8(105)	10.9(147)	5.3(71)	60.5(817)	1350	22.999
	F	11.2(133)	11.1(132)	13.9(165)	6.2(73)	57.5(681)	1184	0.001
	z	3.23	-2.85	-2.29	-0.97	1.53		
	p	0.001	0.004	0.02	ns	ns		
Total	M	16.8(260)	8.8(136)	11.4(176)	6.1(94)	56.9(879)	1545	26.910
	F	14.6(226)	13.4(208)	14.5(224)	5.6(87)	51.9(803)	1548	0.001
	z	1.68	-4.07	-2.57	0.59	2.79		
	p	ns	0.001	0.01	ns	0.005		

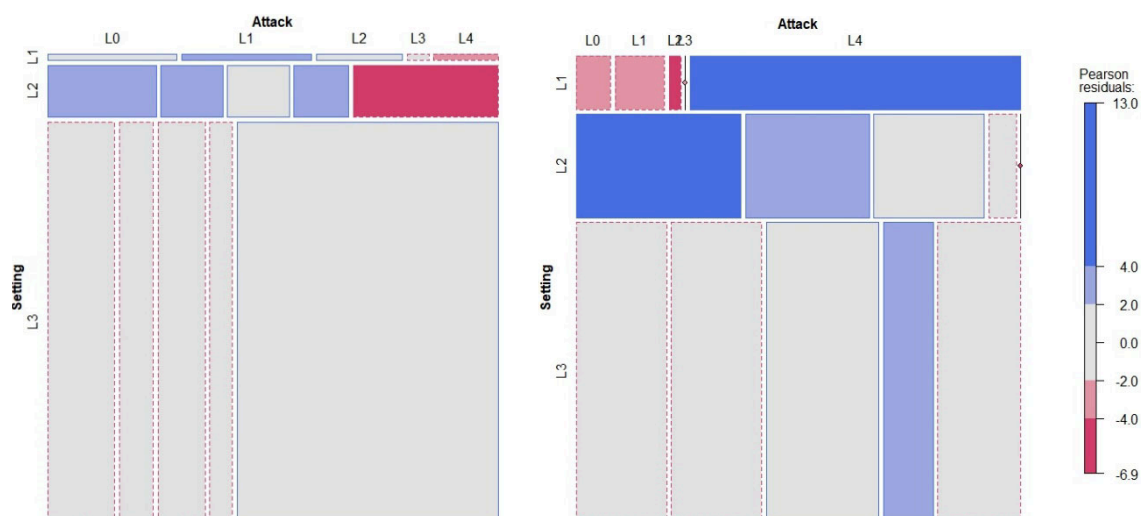


Fig. 5. Mosaic plots of men (left) and women (right)

that the performance of the serve reception affects the performance of the ball setting, while both skills together influence the performance of the subsequent attack hit. Thus, the better the reception and consequently the setting, the higher the offensive performance in both genders (Afonso & Mesquita, 2011; Bergeles et al., 2009; Silva et al., 2013). Moreover, as mentioned above, there were more attacks recorded than settings in the matches. This is widely seen and accepted in BV, because an attack can either occur as a surprising element from a good reception or dig, or it can also be used as a necessary action (Casanova, 2015).

The results of this study confirm the findings of previous research (Koch & Tilp, 2009), as it was found that the types of serve receptions primarily used were the frontal and lateral forearm passes. Simultaneously, it was observed that men were of higher quality than women, who, however, more frequently used other techniques such as dives, one-handed hits, etc. Interestingly, when women utilized these techniques, they exhibited better quality, as they more frequently executed very good and excellent settings compared to men, who made mistakes more often. These differences can be partly attributed to gender-related differences in body dimensions, proportions, and muscular strength (Bishop et al., 1987), as well as to the type and speed of the serves used and the height of the net (Buscá et al., 2012; FIVB, 2021; López-Martínez et al., 2020).

It is well-known that men excel in muscular strength (Bishop et al., 1987), as demonstrated by vertical jumps and the speed of hits, particularly serves, which reach 98.3 ± 4.3 km/h for men and 80.1 ± 2.7 km/h for women (Palao & Valades, 2014). This is also related to BV players' preference for jump serves, especially high-speed spin serves, whose use appears to be decisive at the women's level, as it determines team rankings (Buscá et al., 2012).

Regarding the type of setting, it was found that men compared to women more frequently used overhead settings (63.3% vs. 22.4%), while women did the opposite (77.6% vs. 36.7%). These findings, which align with those of Koch & Tilp (2009), may be due to the higher muscular strength of men, allowing them to move faster and position their bodies under the ball as required by the F.I.V.B. rules and overhead

setting techniques (Bishop et al., 1987). Additionally, body proportions play a significant role, as finger size allows men to handle the ball more easily even in more complex situations (Giannopoulos et al., 2017; Malousaris et al., 2008).

In general, it was evident that men were of higher quality than women, as their settings were often excellent, while women's settings were good. Regardless of the technique used during the setting, it has been established that if the previous action, i.e., the reception, is successful, the quality of the setting helps the team fully develop its tactics. Conversely, a poor reception immediately gives an advantage to the opponent, as the quality and options of the setting are reduced (Marcelino et al., 2014).

The results of this study align with previous research (Häyrinen & Tampouratzis, 2012; Koch & Tilp, 2009), as it was observed that as the quality of the reception increased, the percentage of excellent settings also increased. However, when comparing genders, it was evident that men were of higher quality whether they received moderate, good, or excellent receptions, which may partly be due to their higher percentage of excellent receptions. On the other hand, men's better handling of moderate receptions may have contributed to the outcome, as it has been established that they can more frequently convert them into excellent or good settings compared to women (Barzouka et al., 2019; Palao et al., 2005). Furthermore, under the same reception conditions, women were more likely to execute moderate settings or make errors.

Regarding the types of attack hits, it was found that men more frequently used hard driven balls (986 vs. 544), while women favored the driven balls and poke shots (734 and 213 vs. 402 and 84, respectively), as found in previous studies (Koch & Tilp, 2009). Overall, it was evident that men were more effective than women, which can be explained by their preference for powerful hard driven balls and their tendency to take more risks to win the rally as in Volleyball (Bergeles et al., 2009; Drikos et al., 2022).

Although the performance of most attack hit types did not differ between genders, significant differences were observed in the driven ball and the poke shot. In the first case, women made more mistakes, possibly because they

more frequently resorted to lower power but technically demanding hits like the driven ball, due to their tendency to take fewer risks compared to men. Moreover, despite their increased frequency and technical demands, driven balls often target the edges of the court at low speed, which in some cases makes the ball's trajectory susceptible to weather conditions. In the second case, men, due to their tendency to take risks in attack, used lower-power hits like the poke shot less frequently and only in exceptional cases. Additionally, the height of the opponent's block combined with men's relatively higher physical abilities makes low-power hits less effective. Therefore, men's sporadic and situational use of the poke shot, combined with less ball control due to the small contact area with the fingers' phalanges, may explain the higher error rate compared to women.

The athletes' offensive choices also affect the defensive tactics of both genders. Beyond the blocking technique, which is common in volleyball and beach volleyball, the latter also employs the "peeling off" movement, where players pretend to block but then retreat to playground defense. This defensive technique appears to be used more by women (28%) compared to men (12.8%), according to FIVB data (Beach Volleyball: Picture of the Game, 2015). As mentioned earlier, it has been established that the quality of each action increases as the quality of the previous one improves (Bergeles et al., 2009). However, in this study, it was found that men performed very good attack hits even when they received only good settings more frequently than women. When they received excellent settings, however, they made more mistakes compared to women, who executed moderate (QL1) and good attack hits (QL2), allowing the opposing team to organize their play. This may be due to the higher number of driven ball and poke shot hits (734 vs. 402 and 213 vs. 84, respectively) used by women compared to men, who more frequently chose hard-driven ball hits (986 vs. 554).

The authors acknowledge limitations to the study design. Initially, the sample was limited to the top 32 national beach volleyball teams from a single tournament, potentially restricting generalizability and not reflecting broader performance trends. Secondly, physiological factors were hypothesized but not directly measured, and extraneous variables like weather, court conditions, and team strategies have not been controlled.

Conclusions

In conclusion, men were more effective than women, primarily using the forearm reception, overhead setting and powerful attacking hits, which contribute to higher quality. On the other hand, women used more side and other types of receptions, the forearm pass, driven ball, and poke shot in their attacking hit. It was also evident for both genders that the higher the quality of the service reception, the greater the quality of the setting and the effectiveness of the attack. It is recommended to conduct similar research at different competitive and age levels, as the present study was conducted at a highly competitive level, and its findings may not be generalized.

Conflict of Interest

All researchers declare that there is no conflict of interest in this study.

References

- Casanova, R. M. (2015). *Beach Volleyball: Picture of the Game*. In FIVB.
- Hank, M., Malý, T., Zahálka, F., Dragišký, M., & Bujnovský, D. (2016). Evaluation of the horizontal movement distance of elite female beach volleyball players during an official match. *International Journal of Performance Analysis in Sport*, 16(3), 1087-1101. <https://doi.org/10.1080/24748668.2016.11868950>
- Kumar, P. (2015). Impact of Sand Training for Endurance Development among Athletes. *IJAR*, 1(7), 503-506.
- Pinnington, H. C., & Dawson, B. (2001). The energy cost of running on grass compared to soft dry beach sand. *Journal of Science and Medicine in Sport*, 4(4), 416-430. [https://doi.org/10.1016/S1440-2440\(01\)80051-7](https://doi.org/10.1016/S1440-2440(01)80051-7)
- Palao, J. M., Gutiérrez, D., & Frideres, J. E. (2008). Height, weight, Body Mass Index, and age in beach volleyball players in relation to level and position. *The Journal of sports medicine and physical fitness*, 48(4), 466-471.
- Freire, R., Hausen, M., Pereira, G., & Itaborahy, A. (2023). Body Composition, Aerobic Fitness, Isokinetic Profile, and Vertical Jump Ability in Elite Male and Female Volleyball and Beach Volleyball Players. *Journal of Science in Sport and Exercise*, 5(4), 385-395. <https://doi.org/10.1007/s42978-022-00192-y>
- Tilp, M., Koch, C., Stifter, S., & Ruppert, S. G. (2006). Digital game analysis in beach volleyball. *International Journal of Performance Analysis in Sport*, 6(1), 140-148. <https://doi.org/10.1080/24748668.2006.11868362>
- Medeiros, A. I. A., Marcelino, R., Mesquita, I. M., & Palao, J. M. (2017). Performance differences between winning and losing under-19, under-21 and senior teams in men's beach volleyball. *International Journal of Performance Analysis in Sport*, 17(1-2), 96-108. <https://doi.org/10.1080/24748668.2017.1304029>
- Eom, H. J., & Schutz, N. R. (1992a). Transition playing team performance of volleyball: A log linear analysis. *Research Quarterly for Exercises and Sport*, 63(3), 261-269.
- Eom, H. J., & Schutz, R. W. (1992b). Statistical analyses of volleyball team performance. *Research Quarterly for Exercise and Sport*, 63(1), 11-18. <https://doi.org/10.1080/02701367.1992.10607551>
- Tabachnick, B. G., & Fidell, L. S. (2019). *Using Multivariate Statistics* (7th ed.). Pearson.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
- Altman, D. G. (1991). *Practical statistics for medical research*. Chapman and Hall.
- Kortlik, J. W., & Williams, H. A. (2003). The incorporation of effect size in information technology, learning, and performance research. *Information Technology, Learning, and Performance Journal*, 21(1), 1-7.
- Meyer, D., Zeileis, A., & Hornik, K. (2020). vcd: Visualizing Categorical Data. *R Package Version 1*, 4-7. <https://rdr.io/cran/vcd/>
- Zeileis, A., Meyer, D., & Hornik, K. (2007). Residual-based shadings for visualizing (conditional) independence. *Journal of Computational and Graphical Statistics*, 16(3), 507-525. <https://doi.org/10.1198/106186007X237856>
- Bergeles, N., Barzouka, K., & Nikolaidou, M. E. (2009). Performance of male and female setters and attackers on

- Olympic-level volleyball teams. *International Journal of Performance Analysis in Sport*, 9(9), 141-148. <https://doi.org/10.1080/24748668.2009.11868470>
- Afonso, J., & Mesquita, I. (2011). Determinants of block cohesiveness and attack efficacy in high-level women's volleyball. *European Journal of Sport Science*, 11(1), 69-75. <https://doi.org/10.1080/17461391.2010.487114>
- Silva, M., Lacerda, D., & João, P. V. (2013). Match analysis of discrimination skills according to the setter attack zone position in high level volleyball. *International Journal of Performance Analysis in Sport*, 13(2), 452-460. <https://doi.org/10.1080/24748668.2013.11868661>
- Koch, C., & Tilp, M. (2009). Beach volleyball techniques and tactics: A comparison of male and female playing characteristics. *Kinesiology*, 41(1), 52-59. <https://www.researchgate.net/publication/228659523>
- Bishop, P., Cureton, K., & Collins, M. (1987). Sex difference in muscular strength in equally-trained men and women. *Ergonomics*, 30(4), 675-687. <https://doi.org/10.1080/00140138708969760>
- Buscá, B., Moras, G., Javier, P., & Rodríguez-Jiménez, S. (2012). The influence of serve characteristics on performance in men's and women's high-standard beach volleyball. *Journal of Sports Sciences*, 30(3), 269-276. <https://doi.org/10.1080/02640414.2011.635309>
- FIVB. (2021). *Official Volleyball Rules 2021-2024*. FIVB. <https://www.fivb.com>
- López-Martínez, A. B., Palao, J. M., Ortega, E., & García-De-Alcaraz, A. (2020). Efficacy and manner of execution of the serve in top-level women's beach volleyball players. *Journal of Physical Education (Marín)*, 31(1). <https://doi.org/10.4025/JPHYSEDUC.V31I1.3142>
- Palao, J. M., & Valadés, D. (2014). Normative profiles for serve speed for the training of the serve and reception in volleyball. *The Sport Journal*, 17, 1-10.
- Giannopoulos, N., Vagenas, G., Noutsos, K., Barzouka, K., & Bergeles, N. (2017). Somatotype, Level of Competition, and Performance in Attack in Elite Male Volleyball. *Journal of Human Kinetics*, 58(1), 131-140. <https://doi.org/10.1515/hukin-2017-0082>
- Malousaris, G., Bergeles, N., Barzouka, K., Bayios, I., Nassis, G., & Koskolou, M. (2008). Somatotype, size and body composition of competitive female volleyball players. *Journal of Science and Medicine in Sport*, 11(3), 337-344. <https://doi.org/10.1016/j.jsams.2006.11.008>
- Marcelino, R., Afonso, J., Moraes, J. C., & Mesquita, I. (2014). Determinants of attack players in high-level men's volleyball. *Kinesiology*, 46(2), 234-241.
- Häyrinen, M., & Tampouratzis, K. (2012). Technical and tactical game analysis of elite female beach volleyball. *KIHU: Research Institute for Olympic Sports*. <https://www.researchgate.net/publication/271209229>
- Barzouka, K., Sotiropoulos, K., Tsavdaroglou, S., & Kosiva, E. (2019). Comparison of elite male and female volleyball setters regarding the time-zone setting choice and their performance per rotation. *Exercise & Society*, 63, 26-38.
- Palao, J. M., Santos, J. A., & Ureña, A. (2005). The effect of the setter's position on the spike in volleyball. *Journal of Human Movement Studies*, 48(1), 25-40.
- Drikos, S., Sotiropoulos, K., Gkrekka, S., Tsakiri, M., & Barzouka, K. (2022). Variations in Attack Patterns between Female and Male outside hitters in top-level Volleyball. *International Journal of Sports Science & Coaching*, 17(2), 174795412210757. <https://doi.org/10.1177/17479541221075723>

Порівняльний аналіз виконавської майстерності комплексу I у пляжному волейболі серед спортсменів чоловічої та жіночої статей

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 11 с., 5 табл., 5 рис., 32 джерела.

Мета дослідження. Метою цього дослідження було проаналізувати та оцінити результативність застосування різних видів навичок серед гравців чоловічої та жіночої статей у Комплексі I.

Матеріали та методи. Дослідження охоплювало 28 чоловічих та 26 жіночих матчів, які представляли 32 національні команди, що брали участь у фіналі Світового туру ФІВБ 2019 року. Загалом було зафіксовано та проаналізовано 3624 послідовності Комплексу I. Навички виконання пасу (прийом та специфічна передача м'яча зв'язуючим гравцем, який направляє м'яч нападаючому для виконання удару) оцінювалися за чотирирівневою шкалою рейтингу якості тактики, а атакуючі удари — за п'ятирівневою шкалою. Тест на визначення обсерваційної надійності продемонстрував високий коефіцієнт кореляції.

Результати. Гравці чоловічої статі в пляжному волейболі загалом продемонстрували вищу якість (рівень якості — QL3) у прийомі подачі та передачі м'яча з позиції зв'язуючого, а також більшу ефективність (QL4) у виконанні нападаючих ударів порівняно з жінками. Чоловіки частіше використовували базову техніку виконання передачі передпліччям

при прийомі м'яча ($p = 0.001$), верхню передачу ($p = 0.001$) з позиції зв'язуючого та сильний нападаючий удар ($p = 0.001$) при атакуючих діях, порівнюючи з гравцями жіночої статі. Натомість жінки частіше використовували бічну передачу передпліччям та інші техніки прийому м'яча ($p = 0.001$ та $p = 0.001$ відповідно), нижню передачу з позиції зв'язуючого ($p = 0.001$) та техніки сильного й атакуючого ударів, що виконуються зігнутими пальцями, використовуючи кісточки, щоб завдати швидкого та точного удару по м'ячу при атакуючих діях ($p = 0.001$ та $p = 0.001$ відповідно). Крім того, чим вища якість прийому подачі, тим краща якість виконання передачі зв'язуючим гравцем ($p < 0.001$), а чим вища якість виконання передачі з позиції зв'язуючого, тим ефективніша атака ($p < 0.001$) для обох статей. Зрештою, результати показали, що чоловіки-спортсмени частіше виконували відмінні передачі з позиції зв'язуючого, ніж жінки-спортсменки ($p = 0.02$, $p = 0.001$ та $p = 0.001$ відповідно), незалежно від рівня якості прийнятої подачі.

Висновки. Гравці чоловічої статі виявилися ефективнішими за гравців жіночої статі, оскільки вони насамперед використовували техніку фронтального прийому, верхню передачу з позиції зв'язуючого та потужні атакуючі удари, що підвищило загальну якість їхньої гри. З метою узагальнення отриманих результатів рекомендується провести подальші дослідження різних змагальних рівнів та вікових категорій.

Ключові слова: результативність, технічні навички, комплекс I, пляжний волейбол, гендер.

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