

**A COBERTURA DE ATAQUE EM VOLEIBOL DE ALTO  
NÍVEL FEMININO E MASCULINO. ESTRUTURAS E  
REGULARIDADES EMERGENTES DO JOGO.**

Lorenzo Iop Laporta

Porto, 2014.



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Dissertação apresentada com vista à obtenção do grau de Mestre em Ciências do Desporto, na área de especialização em Treino de Alto Rendimento Desportivo, nos termos do Decreto-Lei nº216/92 de 13 de Outubro.

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**Palavras chave:** Análise do jogo, voleibol, complexos de jogo, cobertura de ataque.

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O voleibol segue uma lógica básica dos fundamentos de jogo, que contribuem e dão eficiência para que as melhores decisões sejam tomadas ao longo dos sets. Assim como na vida, estes são importantes para que a frente às adversidades e os tropeços diários, se alcance um nível elevado de sucesso. Com isso vocês fizeram com que esta etapa da minha vida seja repleta de pequenas vitórias e derrotas na busca da concretização deste “jogo”.

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## RESUMO

O voleibol vem experimentando constante evolução no que diz respeito ao entendimento e compreensão da lógica do jogo. O incremento da proximidade e intercâmbio entre treinadores e pesquisadores da área tem potenciando a otimização da eficácia do processo de treinamento. Neste sentido, o conhecimento do jogo e suas regularidades assume um caráter de incontornável relevância. Assim, vem aumentando o número e diversidade dos estudos centrados na análise do jogo e da performance desportiva. O voleibol, em particular, é regularmente analisado em função dos complexos de jogo (K), cada um possuindo características distintivas que lhe conferem unidade funcional. A investigação tem enfatizado três complexos (I, II e III), negligenciando o estudo da cobertura de ataque (KIV), afigurando-se esta lacuna como inibidora duma detalhada compreensão do jogo. Nesta perspectiva, o presente estudo buscou catalogar os sistemas emergentes de cobertura do ataque no voleibol de alto nível masculino (Liga Mundial 2012) e feminino (Taça dos Campeões 2013), analisar o seu peso no jogo e, ainda, relacionando-os com outras variáveis do jogo. Considerando os resultados, destaca-se que o KIV ocorreu somente em 3.89% das posses de bola no masculino e 4.1% no feminino. As estruturas emergentes foram múltiplas e divergiram consideravelmente das mencionadas pela literatura da especialidade. Os resultados indiciam que a cobertura de ataque é pouco estruturada, baseando-se em princípios de atuação mas sendo largamente estrangida por fatores situacionais.

Palavras chave: ANÁLISE DO JOGO, VOLEIBOL, COMPLEXOS DE JOGO, COBERTURA DE ATAQUE.



## **ABSTRACT**

Volleyball has been experimenting constant evolution with regard to the understanding and comprehension of the game logic. Increased proximity and exchange between coaches and researchers have enhanced the optimization of the training process's efficiency. In this sense, game knowledge and its regularities assumes a core importance. Thus, the number and diversity of studies focusing on the game analysis and sports performance is increasing. Volleyball, in particular, is regularly analyzed according to the game complexes (K), each having distinctive characteristics that confer them with functional unit. Research has emphasized three complexes (I, II and III), neglecting the study of the attack coverage (KIV), a gap within a framework of detailed understanding of the game. Accordingly, this study sought to catalog the emerging coverage attack systems in men's (World League 2012) and women's (Champions League 2013) high level volleyball, to analyze its weight in the game and also to link them with other game variables. Considering the results, it is emphasized that the KIV occurred in only 3.89% of the possessions of the ball in men and 4.1% in women. Emerging structures were multiple and differed considerably from those mentioned by the literature. The results indicate that attack coverage is poorly structured, based on principles of action but being largely constrained by situational factors.

**Keywords: GAME ANALYSIS, VOLLEYBALL, GAME COMPLEXES, ATTACK COVERAGE.**

## **LISTA DE ABREVIATURAS**

AJ - Análise do jogo

K's – Complexo de Jogo

K0 – Complexo 0

KI – Complexo I

KII – Complexo II

KIII – Complexo III

KIV – Complexo IV

KV – Complexo V

ZA – Zona de Ataque

TA – Tempo de Ataque

# **INTRODUÇÃO**







# INTRODUÇÃO

## 1.1 Justificativa e pertinência do estudo

Nos últimos anos, vem crescendo a importância e o suporte de estudos<sup>1</sup> acerca da *Análise do jogo* (AJ) e sua contribuição na melhoria de processos de entendimento e aprimoramento do jogo (Afonso & Mesquita, 2011; Rabaz et al., 2013; Marcelino et al., 2011; Rodriguez-Ruiz et al., 2011). Com isso, a análise da performance aporta um contributo relevante para a otimização do processo de treinamento, do desenvolvimento da eficácia das equipes através de estratégias que se aproximem da realidade de jogo e da relação de variáveis estatísticas de ocorrência/sucesso ou insucesso, entre outras (Afonso & Mesquita, 2011). Em termos práticos, AJ tenta investigar as relações dinâmicas e funcionais de interação e oposição dos jogadores/equipes/jogos, levando em consideração elementos de performance desportiva, melhorando assim, a visão científica e prática de estudiosos, técnicos e atletas envolvidos (Moraes, 2009). Nelson & Groom (2012) relatam que a AJ é importante para a coleta de informação que podem gerar *feedback* para o desenvolvimento, entendimento e performance competitiva dos atletas. Além disso, a análise pode ajudar aos treinadores a identificar as facilidades e fraquezas dos adversários, gerando assim, informações técnico-táticas pertinentes.

O voleibol, esporte coletivo de não-invasão, complexo e de natureza imprevisível (Buscà & Febrer, 2012; Silva et al., 2013), é hoje praticado pelo mundo inteiro (Rabaz et al., 2013)<sup>2</sup>. Alguns exemplos de estudos recentes da AJ e o voleibol objetivaram a busca de determinantes no resultado do set, assim como os fundamentos que influenciam o resultado, a qualidade de oposição na performance técnica e tática no voleibol de alto nível (Marcelino et al., 2011; Marcelino et al., 2010; Marcelino et al., 2012; Rodriguez-Ruiz et al.,

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<sup>1</sup> Em uma pesquisa rápida a base de dados SCOPUS, disponibilizada pela Faculdade de Desporto da Universidade do Porto (FADEUP), nota-se que as pesquisas científicas voltadas à Análise do Jogo no voleibol cresceram de 33 pesquisas no ano de 1990 a 2000 para 285 de 2001 até os dias de hoje.

<sup>2</sup> O voleibol é, atualmente, um dos esportes mais importantes a nível internacional. A FIVB, com seus 220 filiados às Federações Nacionais, é conhecida pela sua capacidade de adaptar o esporte para o ginásio e recreação ao ar livre. Portanto, não é surpreendente que o Voleibol e Voleibol de Praia constituam um esporte para todas as idades para a prática, sendo a sua aprendizagem divertida e fácil, sem necessidade de instalações complexas e equipamentos.

2011; Silva et al., 2013). Os estudos também estiveram focados nas diferenças de diversas ações de equipes masculinas e femininas de alto rendimento e de categorias de base (Afonso et al., 2010; Costa et al., 2012; Costa et al., 2011; Costa et al., 2010; Marcelino et al., 2010; Nikos et al., 2009).

Certas pesquisas de profundidade analisaram ações mais específicas, tais como os fundamentos e suas relações no resultado final do set. Por exemplo, o ataque (Afonso & Mesquita, 2007; Castro & Mesquita, 2008; Castro et al., 2011; Costa et al., 2011; Costa et al., 2010; Marcelino et al., 2012), o bloqueio (Afonso et al., 2005; Afonso & Mesquita, 2011; Buscà & Febrer, 2012), saque (Arias et al., 2011; Arias et al., 2011; Marcelino et al., 2012), recepção (Costa et al., 2011; Palao et al., 2006) e defesa (Monteiro et al. 2009; Palao et al., 2006). Existe, igualmente, um corpo crescente de análise de posições específicas dos jogadores em quadra, como o levantador (Buscà & Febrer, 2012), centrais (Buscà & Febrer, 2012), atacantes (Afonso & Mesquita, 2011), líberos (Mesquita et al., 2007), entre outros (Afonso et al., 2010; Afonso et al., 2012; Buscà & Febrer, 2012; Maia & Mesquita, 2006; Nikos et al., 2009; Palao & Ahrabi-Fard, 2011).

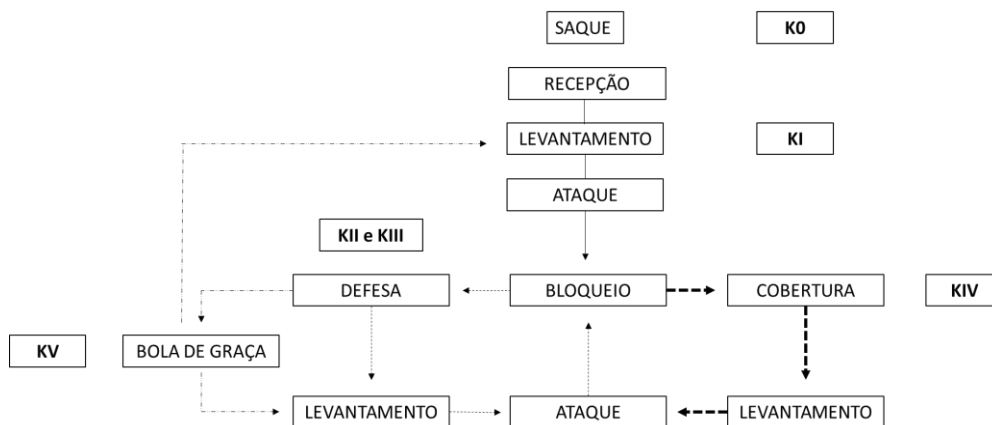
O voleibol segue uma lógica básica dos fundamentos representado pelo saque, recepção, levantamento, ataque, bloqueio e defesa (Castro et al., 2011; Lenberg, 2006; Shondell & Reynaud, 2002). De acordo com a lógica funcional do jogo, o voleibol pode ser dividido em compartimentos ou *complexos de jogo* (*K's*) (Hileno & Buscà, 2012; Monge, 2003; Rodriguez-Ruiz et al., 2011) que revelam a organização, dinâmica e relação entre as situações de oposição/cooperação dentro de cada fase de jogo. Realçam-se os dois principais compartimentos: o *complexo I* (*KI ou side-out*) e o *complexo II* (*KII ou transição*). O primeiro (KI) está associado a uma fase de ataque após recepção de serviço, o segundo à recuperação da posse da bola através da defesa e organização do contra-ataque (KII). Neste sentido, o KI é representado pelas ações de recepção do saque adversário, distribuição I e ataque I, enquanto o KII caracteriza-se pelo bloqueio, defesa, distribuição II e contra-ataque (Afonso et al., 2012; Castro et al., 2011; Costa et al., 2012; Hileno & Buscà, 2012; Mesquita et al., 2010; Monteiro et al., 2009; Palao & Santos, 2004; Palao et al., 2004).

Cada fase do jogo é afetada por uma ação anterior, que influenciará na próxima ação da jogada objetivando o sucesso da ação. Por possibilitar um maior tempo de antecipação do saque adversário pelos recebedores e por conter pouca interferência entre o adversário (sacador até o recebedor), o KI possui uma conotação de ser um complexo mais estável e previsível (Mesquita, 2005). Neste complexo há a uma associação com as jogadas mais ofensivas (Rodriguez-Ruiz et al., 2011), ocorrência de ataques mais potentes, um jogo de velocidade mais elevada (Afonso et al., 2005; Castro et al., 2011; Costa et al., 2012), e – especificamente no masculino –, o mesmo é considerado uma fase decisiva do jogo (Afonso et al., 2012). Há autores (Castro et al., 2011; Eleni et al., 2007) que relacionam este complexo e os fundamentos que o compõe com o sucesso no resultado final das partidas. Além disso, muitas análises estão focadas no Complexo I, como a relação da recepção ao saque, a zona de levantamento e a eficácia do ataque (Afonso et al., 2012), a relação da eficácia do ataque após a recepção de diferentes tipos de saque (Costa et al., 2011), ou ainda, comparações entre homens e mulheres no ataque após a recepção em nível olímpico (Nikos et al., 2009)

O *Complexo 2* (KII) é marcado pela busca de conter a tentativa ofensiva da equipe adversária através do bloqueio e defesa, gerando assim uma possibilidade de contra-ataque. Palao et al. (2004) caracterizam o mesmo como sendo a ação de neutralização do ataque adversário e organização do contra-ataque na busca da posse do saque. Este complexo de jogo, por implicar a espera da ação ofensiva adversária – mais complexa e temporalmente mais pressionante do que em KI – caracteriza-se por ser mais instável que o anterior (Mesquita, 2005). Em comparação ao KI, este complexo oferece performances de ataque mais lentas e com um número elevado de bolas altas direcionadas às extremidades (bolas da rede de segurança), fazendo com que a equipe oponente tente se reestruturar defensivamente melhor (Afonso et al., 2005; Costa et al., 2012; Mesquita et al., 2007). Nikos et al. (2009) em uma meta-análise, revelou que alguns dos melhores indicadores de performance de rendimento a nível olímpico localizam-se no complexo II, são eles: o serviço direto, na relação do ataque e do levantamento no contra-ataque e do bloqueio. Nesta mesma perspectiva Marcelino et al. (2010) cita

que o ataque após a defesa (contra-ataque) é um fator de diferenciação entre o sucesso e insucesso.

Entretanto, novas ampliações e especificações surgiram afim de aumentar a sistematização que envolve o dinamismo do jogo e com isso outras divisões surgiram em mais outros compartimentos (K0, KIII, KIV e KV). O K0 é caracterizado pelo saque e seria separado KII, tornando-se um complexo por direito próprio (Monge, 2003; Muñoz, 2007). Do mesmo modo, as ações de contra-ataque advindas do KI seriam KIII (transição de side-out, seria levado em conta o ato de conseguir defender e possivelmente atacar a bola vinda do adversário em recepção ao saque), enquanto que o KIII (*transição*) representaria as situações de transição do KII, ou seja, “contra-ataque do contra-ataque” (ação de contra-ataque não advinda do *side-out* adversário) (Hileno & Buscà, 2012; Monge, 2003; Muñoz, 2007; Palao et al., 2004). No mesmo sentido, o KV representa a organização da equipe às bolas de graça (*freeballs*, caracterizada pelas bolas em que o adversário obteve dificuldade de organização do ataque e envia a bola com facilidade ao adversário) (Hileno & Buscà, 2012; Monge, 2003).



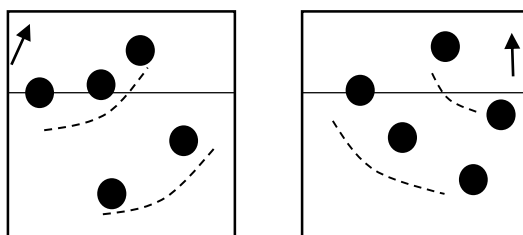
**Figura 1 – sequência cíclica dos complexos de jogo constituída a partir de diversos autores**

O KIV, alvo deste estudo, é caracterizado pela cobertura de ataque ou proteção de ataque (Hileno & Buscà, 2012; Monge, 2003; Muñoz, 2007). Tem como princípio a retomada da posse do ataque após a deflexão no bloqueio adversário, ou seja, quando a bola tocar no bloqueio adversário e retornar a

quadra do atacante, a cobertura tentará repor para que o jogo continue, e resulte na reconstrução da fase ofensiva. Para Barbagallo (1985) e Nicholls (1973), a cobertura é fundamental para o coletivo da equipe e, como tal, o jogador deve estar em prontidão no momento do ataque pelo fato de que a bola ao rebater no bloqueio ela retornará, na grande maioria das vezes, com uma velocidade elevada. A cobertura de ataque inicia-se quando a bola sai das mãos do levantador e é direcionada para algum atacante; os restantes elementos da equipe realizam uma movimentação de aproximação do atacante afim de ficar em estado de espera e construir linhas de cobertura, para que, caso o ataque seja contido pelo bloqueio, possam recuperar a bola e organizar novo ataque. No voleibol de alto nível há situações desfavoráveis de ataque, nas quais o atacante usa desta estratégia para conseguir uma situação melhor e com mais chances de ponto ao atacar, ou seja, o atacante golpeia a bola contra o bloqueio adversário afim de que ela volte e a cobertura consiga formar um novo contra-ataque (Salas, 2006). Nota-se que este compartimento é caracterizado por poucas ações no jogo e que o mesmo ocorre nos dois principais compartimentos de jogo (KI e KII) (Hileno & Buscà, 2012).

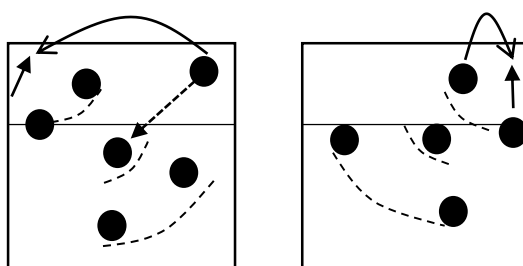
Num estudo recente que analisa o KIV, Hileno and Buscà (2012) criaram uma ferramenta observacional para analisar a cobertura de ataque em alto nível de competição. Após a verificação de qualidade dos dados, os autores analisaram especificamente as situações de cobertura que estavam no complexo 1 e do mesmo lado do observador, excluindo todas as ações em que o líbero não estava em quadra. Foram detectados 19 padrões em diversas situações. Percebeu-se, ainda, que os jogadores tendem a assumir uma área específica de responsabilidade para cada zona de ataque e que a cobertura acaba por ser decisiva em situações pontuais da competição. Todavia, e considerando ser tão escassa a pesquisa científica nesta área, buscamos analisar os livros da especialidade (Asher, 1998; Barbagallo, 1985; Monge, 2003; Selinger & Ackermann-Blount, 1986; Shondell & Reynaud, 2002). Na sequência, notamos que a literatura encontrada é antiga e revela formatações bem estabelecidas compostas por “linhas de cobertura” que nada mais são que uma forma altamente organizada, rígida e sistematizada da disposição dos atletas. Predominantemente, emergem duas sistematizações de cobertura: o

3:2 e o 2:3, em que os primeiros três atletas encontram-se na primeira linha de cobertura (mais próximos ao atacante) e os dois últimos atletas na segunda linha de cobertura (mais afastados do atacante), enquanto que o 2:3 são dois atletas na primeira linha e três afastados (Mesquita, Guerra, Araújo, & Fraga, 2002; Nicholls, 1973; Selinger & Ackermann-Blount, 1986).



**Figura 2 – Linhas de cobertura (sistema 3:2 e 2:3)**

Apesar da similaridade nos desenhos do 3:2 e 2:3, Barachoswki (1995) transforma estes dois sistemas em um único chamado de 2:1:2 (ver Figura 3) em que os dois jogadores mais próximos fariam a primeira linha, para que um fique mais intermediário e dois afastados. O mesmo autor relata, ainda, que quando um jogo mais rápido for empregado, a formação da cobertura pode se tornar menos definida, pois os mesmos não terão tempo de colocar-se na posição definida, isso faz com que os jogadores devam aprender a equilibrar a cobertura nestas situações.



**Figura 3 – Linhas de cobertura (sistema 2:1:2)**

Para Selinger & Ackermann-Blount (1986), a cobertura ajuda o atacante a ter mais confiança, segurança, devendo o atleta ter em mente a sua posição

de cobertura para cada ataque e diferenciando a formação após a fase de recepção e de defesa. As posições de cobertura são afetadas quando a posição do levantador está à frente ou atrás (Barachoswski, 1995; Mesquita et al., 2002). Outro ponto a ser levado para a formação da cobertura é a proximidade da bola junto à rede, na qual a cobertura de ataque deverá estar mais próxima à rede quando os bloqueadores a serem enfrentados forem de grande estatura e com uma capacidade elevada de entrada de braço (invasão ao espaço aéreo oposto) pois a bola poderá tomar uma trajetória para baixo e de grande velocidade, assim como o contrário, quando a bola estiver afastada ou os bloqueadores forem mais baixos a trajetória pode ser mais para o fundo da quadra (Asher, 1998; Barachoswski, 1995; Mesquita et al., 2002).

O nosso estudo ganha, deste modo, pertinência ao analisar os sistemas de cobertura e as variáveis que o condicionam no voleibol de alto rendimento masculino e feminino, visto haver reduzida produção científica e os livros da especialidade estarem desatualizados em relação às exigências do voleibol atual. Em relação ao KIV, será feito um levantamento de ocorrências dos sistemas, como eles são formados e a sua relação com outras variáveis de jogo, nomeadamente: efeito, complexo antecedente e estrutura do KIV; zona e tempo de Ataque; e qualidade da ação de recepção/defesa (zona de distribuição). Esperamos contribuir com uma sistematização numa área por explorar, aportando novidade aos estudos de AJ em voleibol.

## 1.2 Problema e objetivos do trabalho

O principal objetivo do trabalho é catalogar as diversas ocorrências de sistemas de cobertura no voleibol de alta performance masculino e feminino, analisar o peso deste complexo no jogo e relacioná-lo com outras variáveis de jogo e com os sistemas descritos pela literatura existentes.

Para tal, alguns dos questionamentos listados abaixo servirão para o auxílio no problema e na construção e desenvolvimento do trabalho:

## INTRODUÇÃO

- Quais os sistemas de KIV descritos pela literatura?
- Serão esses sistemas coerentes com aqueles que emergem no jogo de alto nível atual?
- Qual a abrangência e profundidade das pesquisas científicas relativamente a este tema?
- Qual a importância real das ações em KIV para o resultado final do jogo?
- No voleibol feminino, por ter um volume maior de contra-ataques, possuirá o KIV maior relevância?
- Qual a relação dos sistemas encontrados com as outras variáveis do jogo?

Com esta dinâmica, as variáveis pertencentes ao trabalho que podem influenciar nos objetivos propostos foram o *complexo antecedente* da ação do KIV e o *efeito* final do mesmo na jogada. Paralelamente serão descritas as formações ou estruturas de KIV emergentes.

A *zona de distribuição* veio do proposto por Esteves & Mesquita (2007), em que a quadra foi dividida em três zonas relacionada com a qualidade e opções que o levantador faria a sua distribuição. Para a *Zona de Ataque (ZA)* foi utilizado a divisão da quadra em seis posições proposto pela FIVB. O *tempo de ataque (TA)* usou-se o padrão formulado por Afonso & Mesquita (2007) dividindo em tempo 0, 1, 2 e 3.

### 1.3 Estrutura do trabalho

O trabalho será composto de três partes principais: I - Introdução geral, II – Estudos científicos e III – Considerações Finais. Logo após será composto de uma lista única de referências a qual foram durante os itens I e III.

A primeira parte abordará de forma ampla algumas ideias centrais que nortearam o trabalho. A Justificativa e pertinência do estudo serão relatados após uma síntese teórica das variáveis que envolvem o tema. E finalizando esta parte estará o problema e os objetivos do estudo.

Em seguida, os dois artigos que irão compor a segunda parte do trabalho:

O primeiro artigo (Estudo I) intitulado *Attack coverage in high-level men's volleyball: organization on the edge of chaos?* e submetido à revista *Journal of Human Kinetics*, analisa sistemas de ocorrência da cobertura de ataque em alto nível masculino de voleibol (Liga Mundial 2012), bem como a sua relação com outras variáveis (Efeito da cobertura, Formação e quantidade de linhas do KIV, Tempo de Ataque, Zona do primeiro toque, Zona de distribuição, Zona de Ataque) que envolvem o KIV.

No segundo artigo (Estudo II), intitulado *Systems of attack coverage in high-level women's volleyball*, e submetido à revista *Kinesiology*, seguiu-se um percurso semelhante, mas no voleibol de alto rendimento feminino (Copa dos campeões 2013).

Por último, teceremos considerações finais envolvendo todos os contributos dos pontos que envolvem a cobertura de ataque abrangente nos dois artigos.



# **ESTUDOS**

## ESTUDO I

## **Attack coverage in high-level men's volleyball: organization on the edge of chaos?**

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### **Abstract**

The need to understand the game has led researchers and coaches in search of a deeper comprehension of its logic in order to assist in improving performance. In this context, volleyball has been divided into game complexes, grouped according to their functional characteristics. Notwithstanding, research has focused almost entirely in complexes I (side-out), II (side-out transition), and III (transition). In this scenario, complex IV (attack coverage) has been highly neglected in scientific research, despite presenting constraints that are exclusive to this game complex. Therefore, our study focused on the occurrence of complex IV and its emerging structures in the 2011 Men's Volleyball World League. Of 4544 ball possessions, only 3.89% promoted the emergence of complex IV, and there was a considerable variability in the emerging structures. The attack coverage structures showed independence of the complex (I or II/III), setting zone (A, B or C), and also attack coverage effect. However, complex IV showed significant association with Attack Zone and Tempo, with a very strong effect size ( $V=0.521$ ). Quicker and more complex attack plays affect complex IV formation, with tempo 1 favoring the formation of one-line systems. Contrary to what the literature on volleyball states, complex IV seems to have reduced weight on the game, and its structures are deeply influenced by momentary constraints, instead of reflecting systematic training.

**Keywords:** performance analysis, systematized training, defensive coverage.

## Introduction

Since its creation, volleyball has become a worldwide practiced sport. Currently, the Fédération Internationale de Volley-Ball (FIVB) has 220 affiliated national federations, and the sport has indoor, beach, and grass versions. Likewise, there have been an increasing number of scientific researches devoted to this sport, of which we highlight studies using Match Analysis (MA). A search in the Scopus database (accessed 27/04/2014, 21:00) using 'volleyball', 'match analysis', and 'notational analysis' as keywords has revealed the existence of two hundred and four papers between 2012 and 2013 alone. Thus, there has been a great contribution to the understanding of the game's logic and functionality in a diversity of themes and using a variety of methods. Besides the scientific interest, such research provides coaches and teachers with a better knowledge of volleyball, hence improving their teaching and coaching abilities (Muñoz, 2007).

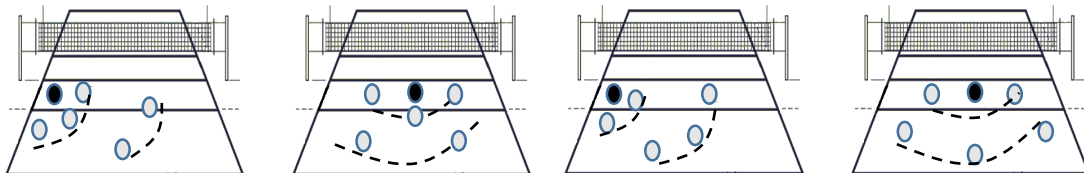
Garganta (2001) highlights some of the main contribution of MA: a) configurations models activity players and teams; b) identification of traces of activity whose presence or absence has relation with process efficacy and scope positive results; c) evolution possibility of the training methods to support higher specificity and, consequently, upper transferability; d) inference of evolution tendency among the different sports' kind. Systematic analysis of the information concerning the match regularities affords understanding the game patterns and configuring more effective models of activity for players and teams (Afonso et al., 2012; Marcelino et al., 2012).

In volleyball, there are game phases or complexes that present considerably different tactical and technical constraints, therefore presenting distinct functional logics and regularities (César and Mesquita, 2006; Nikos et al., 2009; Palao et al., 2004). Two major game complexes are evidenced in volleyball: (a) the KI or side-out is characterized by the serve-reception, attack organization and attack; and (b) the KII or side-out transition, which comprises serve, and the defense system organization by the block, defense and counterattack (Costa et al., 2012). Some authors include yet the KIII, meaning the counter-attack to a previous counter-attack (Hileno and Buscà, 2012).

Despite the solid logic behind such theoretical division, for practical analysis KIII is usually included in KII (Arias et al., 2011; Castro et al., 2011; Costa et al., 2012; Costa et al., 2011). This enhances the number of analyzed counter-attacks and, hence, improves the 'n' and provides power to the analysis.

The KIV, the focus of our study, concerns the attack coverage when facing the opposite blockers, attempting to recover balls deflected by the block back to the attacker's side of the court (Esteves and Mesquita, 2007; Hileno and Buscà, 2012; Monge, 2003). This complex can emerge within any of the other game complexes, e.g., it can occur in consequence of preparing attack coverage within the context of KI or KII/KIII. Notwithstanding, the literature applying MA on volleyball has focused widely on analysing the KI phase (Costa et al., 2012; Costa et al., 2011; Palao and Ahrabi-fard, 2011; Rabaz et al., 2013; Silva et al., 2013) and/or the KII phase (Costa et al., 2012; Costa et al., 2011; Palao et al., 2013; Silva et al., 2013). Consequently, a theoretically important game phase such as KIV has been widely neglected in scientific research, namely the attack coverage.

To the best of our knowledge, there was only a previous study that has examined this game phase this game phase (Hileno and Buscà, 2012). The few references concerning attack coverage are usually retrieved from technical books (Asher, 1998; Barbagallo, 1985; Nicholls, 1973; Selinger and Ackermann-Blount, 1986). Most often, such books consider only two major attack coverage systems: one with a first line of defence formed by two players and the second line by three players (2:3), and another with an inversion of these two lines (3:2) (Selinger, 1986; Nicholls, 1973) (see Fig. 1).



**Figure 1 – Examples of attack coverage systems described in the literature.**

Such stereotyped systems seem to misfit the current complexity of attack models in high-level volleyball. By changing the attack construction, there is interference with the zones where the players are acting, and also with their actual action possibilities with regard to attack coverage (Esteves and Mesquita, 2007; Hilenó and Buscà, 2012). Despite this alert, the theme has not been properly treated in volleyball literature and, as we have seen, has merit nearly no attention in scientific research.

Therefore, the aim of this study was to analyse the attack coverage systems actually occurring in high-level men's volleyball. First, a descriptive analysis of the real patterns emerging from the game was intended. Furthermore, the relationships between such systematic structures and other game variables will be explored.

## **Material and Methods**

### *Participants*

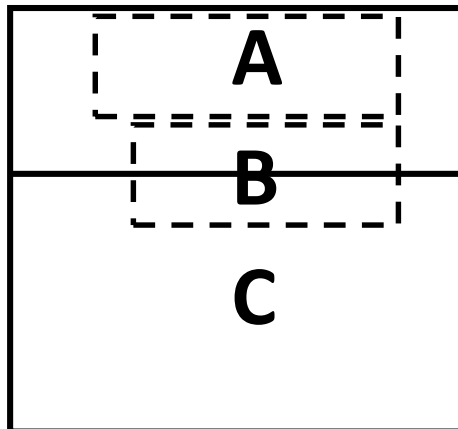
The sample comprised twelve matches of the 2011 Volleyball World League, including the national teams of Argentina, Brazil, Bulgaria, Cuba Italy, Poland, Russia, and United States of America. A total of 45 sets were analysed, including 4544 ball possessions, of which 1579 occurred within the context of KI and 2965 in KII.

### *Measures*

*Game complex* is characterized by the game phase wherein the team is. The KI or side-out is the attack organization after the opposite serve, while the KII (side-out transition or counter-attack) is the recovery of the ball and subsequent counter-attack (Castro and Mesquita, 2008; Castro et al., 2011; Mesquita et al., 2010; Silva et al., 2013).

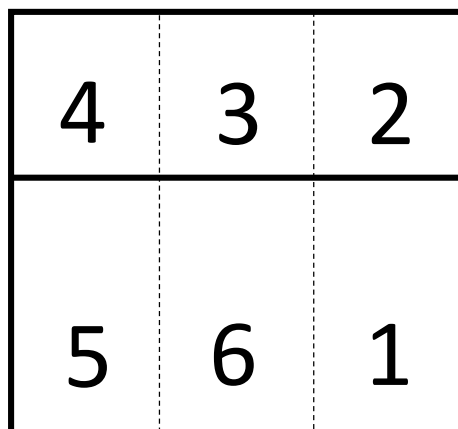
*Setting zone* was evaluated by determining the number of attack options that it provided the setter with. We used a like model proposed by Esteves and Mesquita (2007), which divided the court into three different functional zones. While zone A (localized from the central line until 2m and away from the right side-line 1m and 3m from the left line) affords the setter to play all attack

options he intends to, zone B (localized from the Zone A until 2m and away the right side-line 1m and 4m from the left line) already limits some of the temporal and spatial options, although still affording some quick attacks. Zone C (corresponds to the rest of court) implies setting high balls to the extremities of the court. This variable can also be named *setting zone*, since it represents the zone where the setting will take place.



**Figure 2 – Setting zones.**

The defined *attack zones* were the six official zones of the court (numbered 1 to 6), according to the FIVB rules. As there was a small number of attacks on each of the defensive zones (5, 6 and 1), these three were grouped into a single category termed *second line*.





**Figure 3 – Attack zones.**

*Attack tempo* concerns the synchronization between the setter and the attacker; hence, it implies the notion of timing and not merely a time frame. Three attack tempos were adapted from the four tempos defined Afonso and Mesquita (2007): 1 (the attacker is in the air before, during, or slightly after the set), 2 (the attacker takes two steps after the set), and 3 (the attacker takes three or more steps after the set). We merged tempo 0 into tempo 1, due to their functional similarity and to the small number of occurrences of tempo 0.

With respect to the *KIV structure*, we used a field format, i.e., without pre-established categories. It was our purpose to list and describe all the different structures that emerged within the game. For a player to be considered as effectively participating in attack coverage, he should be on the ground, facing the attacker and/or blockers (e.g., a setter who has jump set and is still in the air when the attack occurs is not actively involved in attack coverage). Besides using all the emerging categories, further analysis also made use of a division using merely the number of KIV lines (counted from the net to the end line).

In table 1, we provide real examples of coverage formations for purposes of illustrating this matter.

**Table 1 - Examples of coverage systems with different number of covering lines**

Coverage lines	Screen shot example
One line	
Two lines	



Finally, *attack coverage effectiveness* reports to the effect of the play after the KIV, i.e. whether the covering team was able to score, or instead lost the point or merely gave continuity to the play.

### *Procedures*

The matches were recorded by a high-definition video camera (Sony® Handycam HDR-CX240, 1080p, USA) positioned circa 9 metres in back of court and at a height of 3 metres, to facilitate video analysis. Data were registered in a worksheet created with Microsoft® Excel® 2013 (Microsoft Office Professional Plus 2013), and later analysed using IBM® SPSS® Statistics Version 21. Rally's score, total actions of the teams, the complex in which the team was playing (KI or KII), setting zone, attack zone and tempo, the occurrence of KIV, and the KIV structure (i.e., distribution of the players in the court) were registered. The study was approved by the Ethics Committee of the University of Porto.

### *Statistical analysis*

Descriptive statistics were used to denote the emerging events and categories. Furthermore, an associative analysis was conducted to scrutinize relationships between the different variables and attempt to find any meaningful patterns. Specifically, a Chi-square testing with Monte Carlo correction was conducted. Where  $p$  was  $\leq 0.05$ , cells containing adjusted residuals above  $|2.0|$  were analysed. Effect sizes were determined by calculating Cramer's  $V$ .

Intra-observer reliability analysis was conducted circa one month after the original observations, and achieved a Cohen's Kappa between 0.83 and 0.89. Inter-observer reliability analysis was conducted by an experienced volleyball coach and researcher and achieved a Cohen's Kappa between 0.76 and 0.86.

## Results

### *Descriptive analysis*

Attack coverage occurred in 174 occasions, corresponding to 3.89% of the plays. Of these, 98 occurred after KI (56.3%), and 76 after KII (43.7%). Twenty-three different KIV structures emerged, grouped into one-line formations, two-line formations, and three-line formations (see Table 2).

**Table 2 – Attack coverage formations**

	<b>Structure</b>	<b>Frequency</b>	<b>Percentage</b>
<b>One line of coverage</b>	1	2	1.1
	2	1	0.6
	3	1	0.6
	4	1	0.6
<b>Two lines of coverage</b>	1//1	2	1.1
	1//2	4	2.3
	1//3	6	3.4
	1//4	1	0.6
	2//1	3	1.7
	2//2	21	12.1
	2//3	32	18.4
	3//1	2	1.1
	3//2	14	8.0
	4//1	4	2.3
<b>Three lines of coverage</b>	1//1//1	2	1.1
	1//1//2	3	1.7
	1//1//3	1	0.6
	1//2//1	7	4.0
	1//2//2	18	10.3
	1//3//1	4	2.3
	2//1//1	7	4.0
	2//1//2	16	9.2
	2//2//1	22	12.6

Coverage systems with merely one line of coverage represented just 2.9% of the total (n=5). Systems with two coverage lines emerged in 51.1% of the cases (n=89), while those with three lines corresponded to 46.0% (n=80).

With respect to attack tempo, tempo 1 occurred in 13.2% of the plays preceding attack coverage (n=23), tempo 2 in 62.1% of the plays (n=108), and tempo 3 in 24.7% (n=43). Attack coverage followed attacks in zone 2 in 26.4% of occasions (n=46), zone 3 in 12.1% (n=21), zone 4 in 52.3% (n=91), and second line in 9.2% (n=16).

Concerning the setting zone, 40.8% of attack coverage occurred after setting in zone A (n=71), 31.6% after setting in zone B (n=55), and 27.6% after setting in zone C (n=48). Finally, 19.0% of attack coverage (n=33) and respective counter-attack resulted in attack error (i.e., they ended up being ineffective), 52.9% afforded keeping the ball in play and prepare another counter-attack (n=92), while 28.2% allowed conquering a point (n=49).

#### *Associative analysis*

When analysing attack coverage formations, there was a significant association with attack tempo ( $\chi^2=94.418$ ,  $p\leq 0.001$ ,  $V=0.521$ ). Several attack coverage formations associated positively with tempo 1: 1 (3.6), 1//2 (2.2), 1//3 (2.7), 1//4 (2.6), 2//1 (2.8), 3 (2.6), and 4 (2.6). Two formations associated positively with tempo 2: 1//2//1 (2.1) and 2//1//1 (2.1). Finally, one formation associated positively with tempo 3: 1//3//1 (2.4).

There was also a significant association between attack coverage formation and attack zone ( $\chi^2=116.197$ ,  $p\leq 0.001$ ,  $V=0.472$ ). Six formations associated positively with attacks in zone 3: 1 (3.8), 1//2 (2.4), 1//4 (2.7), 2//1 (2.9), 3 (2.7), and 4 (2.7). Two formations associated with second line attacks: 3//1 (2.0) and 4//1 (2.9). No significant association was found with game complex ( $p=0.263$ ,  $V=0.385$ ), setting zone ( $p=0.433$ ,  $V=0.359$ ), and effect ( $p=0.766$ ,  $V=0.326$ ).

Respecting number of attack coverage lines, the same trend was verified. There was an association between the number of lines and attack tempo ( $\chi^2=30.288$ ,  $p\leq 0.001$ ,  $V=0.295$ ). One-line coverage systems associated positively with tempo 1 (4.5) and negatively with tempo 2 (-2.0). Two-line

systems associated positively with tempo 1 (2.3). Finally, three-line systems associated negatively with tempo 1 (3.9).

A significant relationship was also found for attack zone ( $\chi^2=35.152$ ,  $p\leq 0.001$ ,  $V=0.318$ ). One-line systems associated positively with attacks in zone 3 (4.7) and negatively with attacks in zone 4 (-2.4). Two-line systems associated positively with attacks in zone 3 (2.4), while three-line systems associated negatively with them (-4.0). Again, there was an absence of association with game complex ( $p=0.411$ ,  $V=0.101$ ), setting zone ( $p=0.187$ ,  $V=0.133$ ), and effect of coverage ( $p=0.749$ ,  $V=0.074$ ).

## Discussion

Volleyball has merited a wide body of research using Match Analysis, but most such analysis fall under the two main game complexes: the side-out or complex I, and the counter-attack or complex II. While complex III may be (and usually is) grouped with complex II, complex IV has been lacking analysis in the scientific literature. Furthermore, volleyball technical books have approached this subject in a highly simplistic and unrealistic basis. Therefore, it was our purpose to analyze the occurrence of KIV in high-level men's volleyball, focusing on the different structures that emerged and their functional meaning.

What first strikes as relevant in our data is the extremely reduced occurrence of attack coverage; despite players positioning themselves in order to fulfill such goal, in only less than 4% of the plays did the attack rebound on the block and back into the attacking team. So, despite high-level coaches and volleyball writers stating that this game complex is relevant and should be trained, the reality shows that, at least for high-level men's volleyball, this game complex has a reduced impact on the game. Moreover, 19.0% of attack coverage actions ended up not being effective, and only 28.2% afforded conquering a point in that play. This adds up to only 1.1% of points being conquered after attack coverage.

Also striking is the number of KIV structures: in just 174 occurrences, 23 different structures emerged, denoting a high variability and, possibly, a great dependence on context variables and on the moment, i.e., on the specific and

immediate constraints of each play. Some formations, however, emerged more often: 2//2 (12.1%), 2//3 (18.4%), 3//2 (8.0%), 1//2//2 (10.3%), 2//1//2 (9.2%), 2//2//1 (12.6%). Any comments regarding why such structures are more common would, however, prove speculative, since our data does not afford attempting to explain why these structures in particular are not other have emerged more regularly. Notwithstanding, what is evident is that most plays afford relatively structured attack coverage structures, as one-lined ones are rare (merely 2.9% of the total).

Attack coverage structure was independent of game complex (I or II) and setting zone (A, B, C). Also, the effect of coverage was independent of the coverage system applied. Nevertheless, attack coverage structure was dependent upon the attack tempo and zone. With regard to attack tempo, the  $V=0.521$  suggests that the two variables may even be considered redundant. Since, due to the nature of game, we know this is not the case, it follows that attack tempo deeply constraints attack coverage structures. Namely, tempo 1 emerged as major factor, as it impaired the utilization of three-line systems and promoted the utilization of one-line systems. High-level volleyball teams have been using quicker and more complex attack plays with the purpose of unbalancing the opponents' blockers, but this will pose a cost in the capacity to cover their own attacks. As tempo 1 is most commonly used in zone 3, it comes as no surprise that zone 3 also promoted one-lined coverage systems, again with a worrisomely strong effect size ( $V=0.472$ ). When only the number of attack coverage lines was considered, the same trends applied, although with much more modest effect size values ( $V=0.295$  for attack tempo and  $0.318$  for attack zone).

Overall, attack coverage does not seem to be relevant for achieving a differential in high-level men's volleyball. Also, the attack coverage systems described in technical books are clearly misguided and do not represent what is a very fluid and plastic reality. The huge variation in attack coverage systems denotes its plasticity and dependence upon immediate conditions. Reaction and intention to cover the attack are more relevant than the specific structure used. We strongly recommend that this subject be thoroughly studied in women's volleyball. Literature has been supporting the notion that there is greater balance between attack and defence in women's volleyball, with consequently

greater rallies, implying more ball transitions. This suggests that KIV may have a higher impact in women's volleyball and may be one of its tenets.

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## ESTUDO II



## **Systems of attack coverage in high-level women's volleyball.**

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### **Abstract**

Understanding the developmental logic of a match assists in structuring game plans. Volleyball is divided into game complexes, each having a particular set of features that merit attention. Research tends to focus on complexes I and II, ignoring other complexes described in the literature. We aimed at analyzing the emerging attack coverage structures (KIV) in the Women's Volleyball World Grand Champions Cup'2013. Overall, 6.815 ball possessions were analyzed and results showed that plays after KIV occur scarcely in the game, and also that a large number of different attack coverage structures emerge. Attack tempo seemed to strongly constraint the emerging structures, but conclusions are tentative. Data suggests that the KIV should be based on principles and not on systematic structures, since an enormous variability of structures was apparent, meaning the KIV is determined largely by momentary constraints and not so much by systematized structures derived from training.

**Keywords:** performance analysis, systematized training, volleyball, attack coverage

### **Introduction**

Volleyball has elicited a considerable amount of research in the last decade, especially within the field of Match Analysis (MA), which has arisen as a tool to help understanding the game logic and the factors impacting on team and athlete performance. Such research has informed training processes to enhance the efficacy of team formation (Afonso, Esteves, Araújo, Thomas, & Mesquita, 2012; Rabaz, Castureira, Arias, Dominguez, & Arroyo 2013; Costa,

Mesquita, Greco, Ferreira, & Moraes, 2010; Marcelino, Sampaio, & Mesquita, 2012; Rodriguez-Ruiz, et al., 2011). Notwithstanding, teamwork is complex and occurs under different sets of constraints. Amongst them, some broad patterns emerge.

In this context, it is possible to identify two main distinct phases within the volleyball game, known as *game complexes*. Complex I (KI) or side-out consists of service reception, setting and attack, while the complex II (KII) is characterized by the serve, blocking, defense and counter-attack (Costa, Afonso, Brant, & Mesquita, 2012; Costa et al., 2011; Rodriguez-Ruiz et al., 2011). Some authors state that other game complexes such as K0 (serve), KIII (transition), KIV (attack coverage) and KV (freeball) all have their own internal logic and, therefore, should be considered in research and in training (Arias, Arroyo, Domínguez, González, & Álvarez, 2011; Hileno & Buscà, 2012). Scientific research has focused strongly on KI (Costa et al., 2012; Eleni, Athanasios, Nikolaos, & Andromahi, 2007; Nikos & Elissavet, 2011; Palao & Ahrabi-fard, 2011) and on KII (Castro & Mesquita, 2010; Castro, Souza, & Mesquita, 2011; Costa et al., 2012; Quiroga et al., 2010), usually including both K0 and KIII within KII. However, scarce attention has been devoted towards KIV and KV.

KIV (i.e., attack coverage), which can follow from any of the traditional complexes (namely, KI and KII), is characterized by the recovery and restructure of the offensive phase after the ball touches the block and returns the attacking team's court (Esteves & Mesquita, 2007; Hileno & Buscà, 2012; Monge, 2003). To our knowledge, only one study has been published concerning this game complex (Hileno & Buscà, 2012). There are several references to the KIV in specialty books (e.g., Asher, 1998; Mesquita, Guerra, Araújo, & Fraga, 2002), from which two main attack coverage structures emerged as systematic organizations. One of them consists of three players near to the attacker and two further away (3//2); the other is the opposite, meaning there are two players near the attack and three further back in the court (2//3). Nonetheless, such simplistic approaches do not seem to correspond well with the velocity and complexity of current attack models in high-level volleyball (Hileno & Buscà, 2012), where a considerable variation is expected to emerge, depending on the specific set of constraints of each play.

In summary, we have noted that this theme is not properly developed either in scientific research or in didactic books. The women's game is more strongly developed in KII than the men's game, promoting the emergence of longer rallies and, consequently, enhancing the theoretical relevancy of blocking and, as such, of attack coverage (César & Mesquita, 2006; Costa et al., 2012; Nikos, Karolina, & Elissavet, 2009). In this vein, our purpose was to scrutinize attack coverage formations in high-level women's volleyball, and also to attempt an understanding of their relationships with other game variables. Furthermore, we targeted at verifying the weight of KIV within the context of the whole match.

## **Methods**

### *Sample*

The sample was comprised of fourteen matches from the 2013 Volleyball Women's World Grand Champions Cup, which includes twelve of the highest ranked National Teams. A total of 52 sets were analyzed, including 6815 ball possessions, 2042 of which occurred in KI and 4773 in KII. The Ethics Committee at the Centre of Research, Education, Innovation and Intervention in Sport of University of Porto provided institutional approval for this study.

### *Instrument*

The matches were filmed with a video camera positioned circa 9 meters from the side of court and at a height of circa 3 meters (Sony® Handycam HDR-CX240, 1080p, USA). Data were registered in a worksheet created with IBM® SPSS® Statistics Version 21. Total actions of the teams, occurrence of KIV, the complex that the team was in the moment of KIV (KI or KII), final effect after of KIV, KIV structure (i.e., player distribution in the court), number of coverage lines, quality of first contact, attack zone and tempo were analyzed.

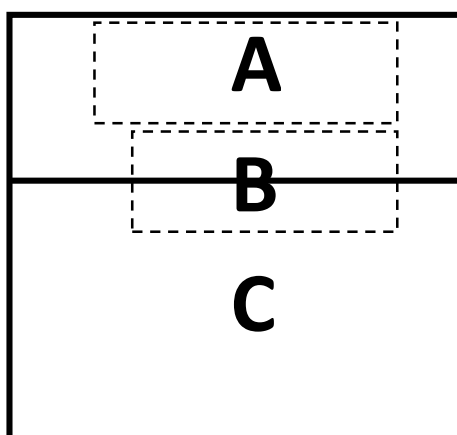
### *Variables*

*Game complex previous to the attack coverage* considered the KI (attack after serve-reception) and the KII (counter-attack)(Castro et al., 2011; Silva, Lacerda, & Joao, 2013).

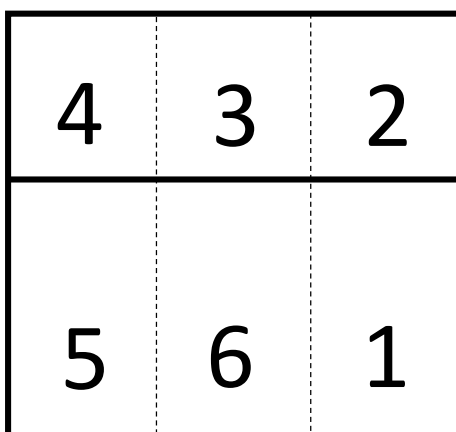
*Quality of the first contact* was evaluated by the number of attack options afforded to the setter, following a model similar to that of Esteves and Mesquita

(2007), according to which we divided the court in three different functional zones (A, B, and C). In zone A the setter had all attack options available; this zone is defined as the region from the center line to 2 meters away and spaced 1 meter from the right line and 3 meters from the left line. Zone B still allows quick attacks, but limits the number of attack combinations available, and is located 2 meters to 4 meters from the center line and laterally 1 meter from the right line and 4 meters from left line. Zone C comprises the remainder of the court, affording only the realization of high sets to the extremities or to the back row. This variable can also be named *setting zone*, since it represents the zone where the action will occur (see Figure 1).

**Figure 1 – Setting zones.**



*The attack zones* were defined according to the FIVB rules, with the court divided into six zones (numbered 1 to 6). For our purposes, zones 5, 6 and 1 were grouped into the category of second line attacks.




**Figure 2 – Attacks zones.**

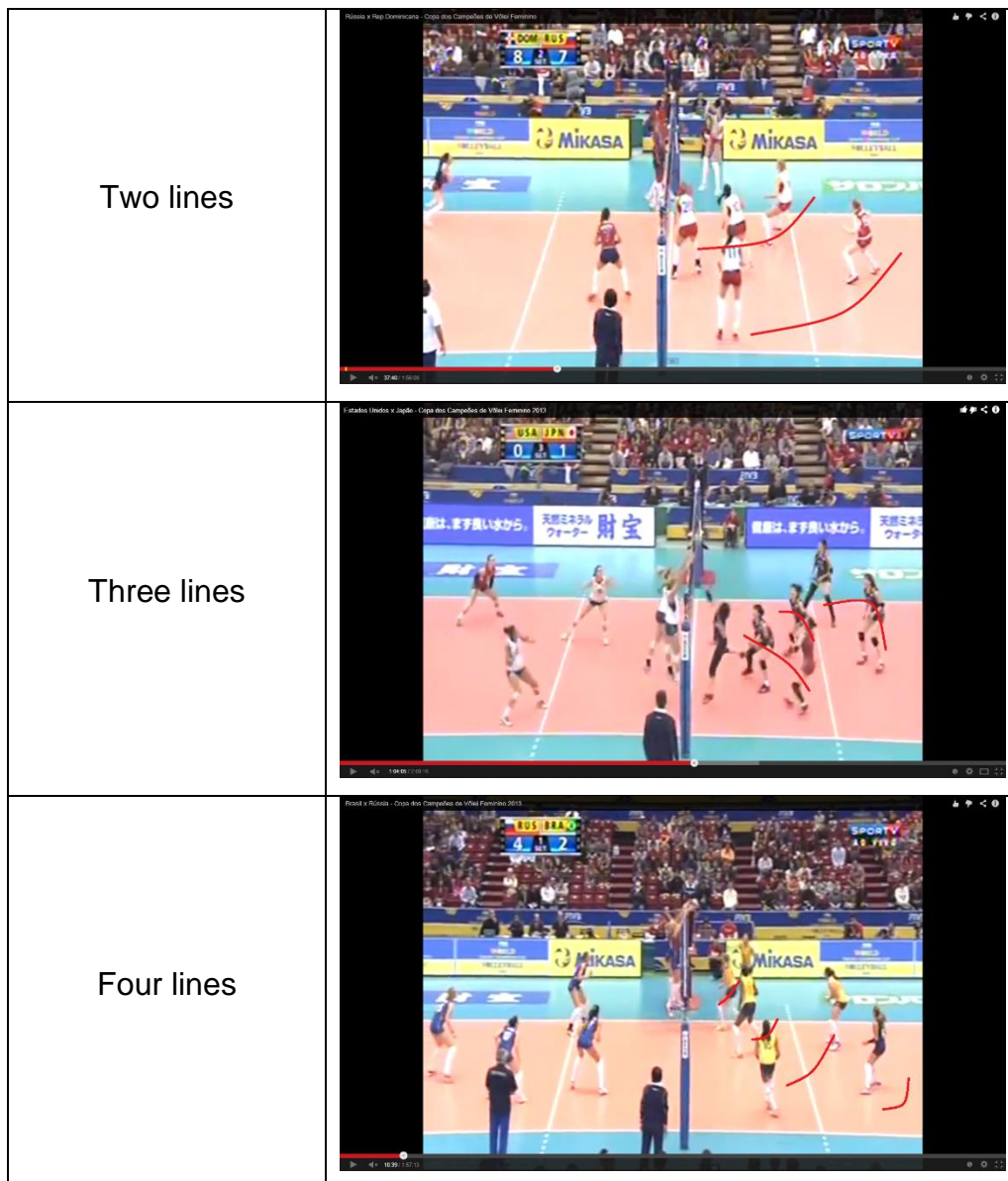
*Attack tempo* emerges from the relationship between the attacker and the setter in the play, implying the notion of timing and not corresponding to a specific time lengths. We defined three attack tempos, based on (Afonso & Mesquita, 2007): 1 (the attacker will be in the air, during or shortly after the set), 2 (after the set, the attacker takes two steps) and 3 (three or more steps taken after the set).

Concerning the *attack coverage structure*, a field format was used, thereby not making use of pre-established categories, as our goal was to list the appearances of all the different structures emerging from the plays. As there are, to our knowledge, no known references defining what an effective attack coverage is, we considered that to participate effectively in attack coverage the player must be facing the attacker and/or the blockers, and be in medium to low position, ready to engage. Moreover, the number of attack coverage lines was measured counting from the net to the end line) (see Table 1).

**Table 1 - Examples of coverage systems with different number of covering lines**

Coverage lines	Screen shot example
One line	

## Attack Coverage in Women's Volleyball



Finally, *attack coverage effectiveness* is characterized by the effect of the play following it: the team terminated the play by scoring, terminated the play by losing the point or the rally continued.

### *Statistical procedures*

Descriptive statistics were used to register the events. Additionally, an associative analysis was performed to examine relationships between the several variables under analysis and attempt to find significant patterns. A Chi-square testing with Monte Carlo correction was conducted. Where  $p$  was  $\leq 0.05$ ,

cells containing adjusted residuals above  $|2.0|$  were analyzed. Cramer's  $V$  was calculated to evaluate the Effect Sizes.

### *Reliability analysis*

Intra-observer reliability analysis was conducted circa one month after the original observations, and achieved a Cohen's Kappa between 0.81 and 0.89. Inter-observer reliability analysis was conducted by an experienced volleyball coach and researcher and achieved a Cohen's Kappa between 0.75 and 0.84.

## **Results**

### *Descriptive analysis*

Attack coverage occurred in 277 occasions, corresponding to 4.1% of the plays. Of these, 128 (46.2%) occurred after KI and 149 (53.8%) after KII. Twenty-nine different KIV structures appeared, divided into four groups: one-line formations, two-line formations, three-line formations and four-line (see Table 2).

**Table 2 – Attack Coverage Formations**

	<b>Structure</b>	<b>Frequency</b>	<b>Percentage</b>
<b>One line of coverage</b>	1	3	1.1
	2	5	1.8
	3	3	1.1
	4	1	0.4
	5	1	0.4
<b>Two lines of coverage</b>	1//1	9	3.2
	1//2	11	4.0
	1//3	12	4.3
	1//4	5	1.8
	2//1	22	7.9
	2//2	33	11.9
	2//3	36	13.0
	3//1	15	5.4
	3//2	20	7.2
	4//1	4	1.4
<b>Three lines of coverage</b>	1//1//1	3	1.1
	1//1//2	2	0.7

## Attack Coverage in Women's Volleyball

	1//1//3	3	1.1
	1//2//1	8	2.9
	1//2//2	10	3.6
	1//3//1	12	4.3
	2//1//1	4	1.4
	2//1//2	21	7.6
	2//2//1	27	9.7
	3//1//1	3	1.1
<b>Four lines of coverage</b>	1//1//1//1	1	0.4
	1//1//2//1	1	0.4
	1//2//1//1	1	0.4
	2//1//1//1	1	0.4

Overall, 4.7% of attack coverage used a system with one line ( $n=13$ ), 60.3% a two-line system ( $n=167$ ), 33.6% a three-line system ( $n=93$ ), and 1.4% a four-line system ( $n=4$ ).

Concerning the quality of first contact, 48.7% of attack coverage occurred after setting in zone A ( $n=135$ ), 38.6% after setting in zone B ( $n=107$ ), and 12.6% after setting in zone C ( $n=35$ ). Attack coverage followed attacks in zone 2 in 28.9% of occasions ( $n=80$ ), zone 3 in 12.3% ( $n=34$ ), zone 4 in 47.3% ( $n=131$ ), and second line in 11.5% ( $n=32$ ). With regard to attack tempo, tempo 1 occurred in 9.0% of the plays preceding attack coverage ( $n=25$ ), tempo 2 in 41.5% of the plays ( $n=115$ ), and tempo 3 in 49.5% ( $n=137$ ), in 1.4% ( $n=4$ ).

Finally, 22.02% ( $n=61$ ) of the attack coverage and respective counter-attack resulted in attack error (i.e., they ended up being ineffective), 58.12% ( $n=151$ ) offered ball continuity in play, and only 23.46% ( $n=65$ ) resulted in scoring a point.

### *Associative analysis*

Attack coverage formations presented a significant association with attack tempo ( $\chi^2=99.416$ ,  $p\leq 0.001$ ,  $V=0.424$ ). Several attack coverage formations associated positively with tempo 1: 1//2 (2.2), 1//4 (5.6), 3//1 (2.5), 5 (3.2). No cell revealed significant associations with tempo 2. Tempo 3 associated negatively with 1//4 (-2.2).

There was also a significant association between attack coverage formation and attack zone ( $\chi^2=124.123$ ,  $p\leq 0.030$ ,  $V=0.386$ ). Three formations associated with attacks in zone 2: 1//1//2 (2.2), 2//1 (-2.6), 2//3 (2.2). Four formations associated with attacks in zone 3: 1 (2.9), 1//4 (4.7), 2//3 (-2.4), 3//1 (3.4). One formation associated negatively with attacks in zone 4 (1//4; -2.1) and one positively with second line attacks: 2//1//1 (2.4).

Finally, there was association with quality of first contact ( $\chi^2=76.615$ ,  $p\leq 0.035$ ,  $V=0.372$ ). The following cells associated with balls passed into setting zone A: 1//3//1 (-2.3), 1//4 (2.3), 2//2 (2.6), 2//3 (-2.7). Balls set in zone B associated with 2//2 (-3.3) and 2//3 (3.0). Associations emerged in the following cells for balls set in zone C: 1//1//1//1 (2.6) and 1//2//1//1 (2.6), 1//3//1 (2.2). No significant association was found with game complex ( $p=0.538$ ,  $V=0.310$ ) and attack coverage effect ( $p=0.101$ ,  $V=0.355$ ).

In respect of number of attack coverage lines, there was an association between the number of lines and game complex ( $\chi^2=9.554$ ,  $p=0.023$ ,  $V=0.186$ ). KI associated positively with the emergence of two-line systems (2.4) and negatively with three-line systems (-2.3). The inverse relationships were observed for KII.

No association was found between number of coverage lines and quality of first contact ( $p=0.203$ ,  $V=0.124$ ), attack zone ( $p=0.145$ ,  $V=0.127$ ), attack tempo ( $p=0.117$ ,  $V=0.136$ ), and effect of attack coverage ( $p=0.179$ ,  $V=0.127$ ).

## Discussion and Conclusion

The contribution of match analysis is growing in sports. In volleyball, research in this area has devoted much attention to KI and KII, but the literature mentions other game complexes with proper specificity and relevance within the game. Among such complexes, the attack coverage (complex IV or KIV) has merited the attention of merely one scientific study to our knowledge (Hileno & Buscà, 2012), despite emerging in almost every specialty book has being important and having to be trained and systematized. Therefore, our purpose was to analyze the occurrence of KIV in high-level women's volleyball, cataloguing the diverse emerging systems, as well as unfolding relationships of such emergences with other game variables of interest.

We first highlight that actions immediately following attack coverage or KIV correspond to roughly 4.0% of the total number of game actions. Such value strongly suggests that this game complex may not be so relevant for the final result in a match, thereby legitimizing the scarce scientific research concerning this topic. However, it is well known that results at the highest levels of performance often rely in details that make all the difference. Nonetheless, other data leaves even less optimistic: if we consider only the successful attack coverage (i.e., those resulting in scoring a point), the percentage falls from 4.0% to around 1.0%.

This strongly advises against the need to systematize attack coverage systems. The effective positions and roles of the players will depend deeply on each play's situational constraints. Thus, the previous position of the player and the speed and complexity of the attack organization will interfere decisively with what kind of structure in attack coverage might emerge. Furthermore, the emergence of 29 different attack coverage formations in such a reduced number of occurrences denotes the high structural variability in KIV. Of these structures only two presented a rate of occurrence greater than 10%, namely the 2//2 structure with 11.9%, and the 2//3 structure with 13%. The 3//2 structure, one of the classic systems depicted in nearly every volleyball book, occurs in only 7.2% of the situations.

Notwithstanding, the association between attack tempo and attack coverage structure revealed an effect size of  $V=0.424$ , which is considered *worrisomely strong*, meaning either an extremely good relationship or that the two variables are measuring the same concept. Thus, in spite of being difficult to derive conclusions from such disperse data, the fact remains that attack tempo (especially tempo 1) seems to highly constraint the type of organizations possible in each attack coverage sequence. The very strong effect size verified for the association between attack coverage systems and attack zone ( $V=0.386$ ) is, we believe, a side effect of attack tempo. Since quicker attack tempos usually associated with zone 3, and slower attack tempos with zones 2, 4, and 2<sup>nd</sup> line, attack zone and attack tempo are likely to be strongly associated. We extend this reasoning to the quality of first contact ( $V=0.372$ ), as it severely constraints the options that are available for developing quicker attacks.

In summary, the nature of the volleyball game promotes few occurrences of plays under complex IV. Two major factors may contribute to this characteristic: a) when the attacker faces the block, he might miss the attack, score a point, or simply put the ball in the opponent's court, with or without a touch in the block; the percentage of situations in which the block deflects on the block and returns to the attacking team's court is quite small, b) Once the ball does return to the attacking team's court after being deflected by the block, most of the time it results in a point by the blocking team; on fewer occasions, the team is able to defend the ball, but not allowing the construction of an organized attack; on very few occasions, the team will be able to counter-attack and score a point.

The emerging associations between the emerging attack coverage structures and game variables such as attack tempo, game complex, and others were scarce and, in our opinion, do not present meaningful relationships, despite being statistically significant. There is considerable variation and no clear pattern seems to emerge. So, is it possible to reconcile the possibility of small details making the difference at the very high-level of performance with the reduced occurrence of plays under KIV and its enormous variation in emerging structures? We believe so. This game complex should be practiced not in a highly systematic manner, but rather under the *principle of coverage*, meaning that every player should practice the habit of attempting to cover the attack. How and where she will effectively cover, that is for the game's situational constraints to determine. Notwithstanding, we suggest that much research is warranted to better understand the actual role of complex IV in high-level women's volleyball.

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**CONSIDERAÇÕES**

**FINAIS**



## CONSIDERAÇÕES FINAIS

Apesar da sua reconhecida importância na literatura da especialidade, a cobertura de ataque tem sido alvo de quase nula atenção na investigação científica, que privilegia a análise dos complexos I, II e III. A pouca literatura existente relacionada ao KIV é antiga e inadequada ao voleibol atual, onde a formação de sistemas de cobertura é mostrada de uma forma rígida e com zonas bem determinadas para cada posição de ataque, negligenciando sistemas de ataque combinados e rápidos.

Os nossos resultados revelaram que, no masculino, as ações de cobertura do ataque ocorreram em apenas 3.89% das posses de bola, enquanto que no feminino foram de 4.1%. Destes valores, as ações após KIV que resultaram em erro foram de 19% (no masculino) e 22.9% (no feminino), enquanto as ações que geraram continuidade corresponderam a 52.9% e 54.5%, respetivamente. Somente 28.2% (masculino) e 23.5% (feminino) das ações de cobertura resultaram em pontos.

A variabilidade de sistemas de cobertura encontrados no alto nível foi muito elevada e não representaram somente nos sistemas de cobertura como o 3//2, 2//3 e 2//1//2 tratados na literatura. Com efeito, emergiram 23 estruturas diferentes no masculino (sendo as mais frequentes 2//2, 2//3, 3//2, 1//2//2, 2//1//2, 2//2//1) e 29 no feminino (com destaque para 2//1, 2//2, 2//3, 3//2, 2//1//2 e 2//2//1). É evidente uma considerável dispersão das estruturas emergentes. Aliada à reduzida percentagem de ocorrência de KIV, os dados indicam que a cobertura de ataque deve ser trabalhada em função de princípios (por exemplo, *quem está disponível cobre*) e não de sistemas rígidos e pré-determinados.

Ao tratar especificamente de cada estudo, nota-se no masculino a interferência do tempo de ataque na formação de linhas de cobertura, em que, como as equipas de alto rendimento tentam causar dificuldade ao bloqueio adversário com ataques mais rápidos e complexos, as estruturas que possuem mais atletas nas linhas de cobertura tornaram-se raras nas bolas com mais velocidade.

No feminino, notamos que a literatura tem vindo apoiar a ideia de equilíbrio entre as ações de ataque e defesa, e de complexos que envolvem o contra-ataque, porém ao seguir esta lógica vimos que este fator não contribui à formação de sistemas de cobertura tendo em vista o valor escasso de ações de KIV (4,01%). Novamente o tempo de ataque mostrou-se um dificultador nas estruturas de cobertura mais complexas

Apesar das variáveis de jogo (tempo de ataque, zona de ataque e complexo de jogo) serem estatisticamente significativas relacionadas com as estruturas de KIV reveladas, as associações mostraram-se escassas e, na nossa opinião, não apresentam relação significativas onde muita variação e nenhum padrão foram revelados.

A elevada diversidade de sistemas de cobertura demonstra que estes dependem de condições momentâneas do jogo e não de sistemas resultantes de treinamento sistematizado, havendo assim um equívoco por parte da literatura existente no que diz respeito ao voleibol atual. A baixa percentagem de ocorrências (em média, 4%) trouxe o questionamento do quanto este complexo é *realmente* importante para alcançar um diferencial no resultado final no voleibol de alto nível. O atacante visa o ponto diretamente à quadra, ou fazer com que a bola toque no bloqueio e vá para fora resultando no ponto, porém quando a bola toca no bloqueio e retorna pra quadra do atacante revelou uma percentagem muito baixa de êxito e muito alta para o erro.

Todavia, particularmente nas grandes competições mundiais, nota-se um considerável equilíbrio, sendo muitos sets decididos por apenas 2 pontos de diferença no marcador. Então fica o questionamento: será que vale a pena treinar este detalhe para que ele melhore ainda mais o nível do voleibol de alto nível? Pensamos que sim, porém não da forma e com o impacto que vem sendo mostrado na maioria dos livros que se reportam a este tema, mas sim de um modo no qual o atleta crie o hábito de tentar cobrir o ataque, possua um instinto de auxílio ao colega atacante, ciente de que cada ação de cobertura poderá assumir um peso decisivo no resultado final.

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