

Cardiff School of Sport
DISSERTATION ASSESSMENT PROFORMA:
 Empirical ¹

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Comments	Section		
	Title and Abstract (5%) Title to include: A concise indication of the research question/problem. Abstract to include: A concise summary of the empirical study undertaken.		
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CARDIFF METROPOLITAN UNIVERSITY
Prifysgol Fetropolitan Caerdydd

CARDIFF SCHOOL OF SPORT

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**Which man up tactic is more effective at scoring goals
in water polo?**

**Dissertation submitted under the discipline of
Performance Analysis**

Chloe Laister

St20007348

WHICH MAN UP TACTIC IS MORE EFFECTIVE AT SCORING GOALS IN WATER
POLO?

Cardiff Metropolitan University Prifysgol Fetropolitan Caerdydd

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Abstract

It has been identified that as much as one third of a water polo match is played in man up situations (Nitzkowski, 1994). During these man ups, there are two formations that are usually used: 4-2 and 3-3. The aim of the study was to compare different variables in the 4-2 and 3-3 formation to evaluate whether one formation produces more goals than the other.

15 FINA world championship matches from 2011 were analysed using a hand notation system. Data, for variables were identified from previous research and collected for analysis were: where the shot was taken from, the number of passes, the type of shot, duration of man up and whether the shot scored or not.

Using Mann-Whitney U tests, significant differences were found between the man up type and the position of where the shot came from $p < 0.005$, gender and the position of where the shot came from produced a difference of $p = 0.010$, gender and the man up type had a significant result of $p = 0.008$, gender and the number of passes $p = 0.018$, gender and the time taken to have a shot on target resulted in $p = 0.000$.

The study found that the 4-2 formation was used more than the 3-3 but there was only a 1% difference in success rate of the number of goals scored from attempts for each man up type. The most successful position to take the shot from in the 4-2 formation is position 2, see figure 1. Position 5 is the best for the 3-3 formation. Females spend 2.98 seconds longer to take the man up shot and 0.91 more passes than males.

CHAPTER 1
INTRODUCTION

Chapter 1: Introduction

1.0 Introduction

Water polo is the longest running team sport in the Olympics (D'Auria & Gabbett, 2008). It is an invasive game with a unique combination of swimming, throwing and martial arts (Franic, Ivkovic & Rudic, 2007) and the overall aim of the sport is to score as many goals as possible whilst defending their own goal. It is played in most countries all of which have international teams who compete on a regular basis (Barr & Gordon 1980). Each team has six players, one goal keeper and six substitutes. Recent rule changes to the game now consist of eight minute quarters instead of seven, and a thirty second shot clock instead of 35 and 20 second exclusions instead of 35.

1.1 Tactic formations

It has been estimated that one third of a game is played in a man up situation (Nitzkowski, 1994). As a result of man ups, Nitzkowski (1994) concluded that 47% of goals scored were down to these. The success rates of shots were higher during a man up situation of 37% compared to 27% when the teams were even.

A man up occurs when a player commits a major foul thus getting sent out. Major fouls include (Barr & Gordon, 1980):

- Committing a foul within four metres of the goal.
- Committing an act of brutality against another player.
- Sinking an opponent.
- Entering the water in an incorrect way when substituting.

There are two main attacking formations that the attacking team can use for a chance at having a shot on goal. The main two options are a 4-2 and 3-3. Occasionally the team may decide to use a combination of the two. Due to the defending team being a man down, the attacking team should have a free player to have a clear shot with the goal keeper not set. The player sent out will only be out of play for twenty seconds so it is important for the formations to be set up quickly. The figures below show how the two formations are typically and approximately set up after a player has been sent out.

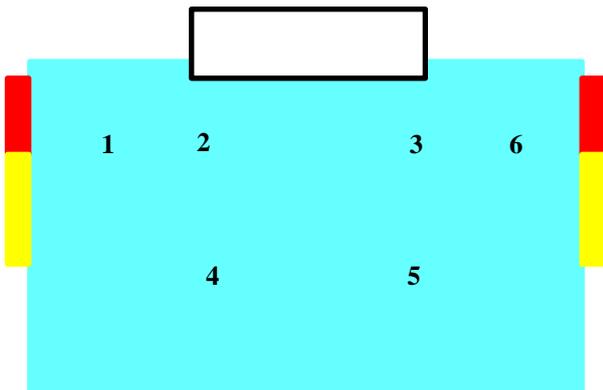


Figure 1. The 4- 2 formation

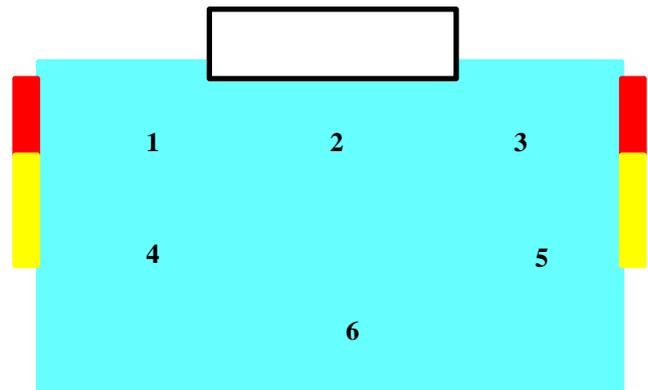


Figure 2. The 3-3 formation

The 4-2 formation places four players across the two metre line. The other two players are placed further back from the goal at about six metres. This layout creates the greatest number of shooting opportunities (Nitzkowski, 1994), as the free player should have more space to shoot due to the defenders being further out marking the four players on the two metre line as these players are the main contenders to score. Positions four and five will be tightly marked so the ball will usually be passed between the players on the two metre line. There are however weaknesses with this formation. It may be difficult to employ in narrow pools due to the width (Nitzkowski, 1994). Generally the four-two is more suited to experienced players as the passes need to be longer and more accurate.

The 3-3 formation places three players across the two metre line and three in a flat triangle at five metres (Nitzkowski, 1994). This layout will be quicker to set up than the four-two as the players should almost be in that formation when they are attacking and setting up the arc. Three defenders will be marking the attackers on the two metre line, so usually the ball will be passed between the three players at the five metre line for majority of the time because that is where the free player will be. When the opportunity arises one of them will put the shot away.

If the defence are making it difficult for an attacker to take a shot on goal, the attacking team may combine the two formations to give themselves more space close to the goal and to confuse the opposition allowing more time to get the shot away.

1.2 Performance Analysis in Waterpolo

“In water polo, there is a lack of codified methodology for tactics training” (Gaetano, Anunziata, Salvatore & Ricardo, 2011, p. 358). This suggests there has been little performance analysis research into water polo particularly the player up tactics. Alfredo and Gaetano (2012) recently conducted studies into tactical play for attacking patterns. They concluded that there were no significant results on tactical play for the player up offence or defence.

1.3 Purpose/ aim

The purpose of the current research was to evaluate whether there is a difference between the 3-3 and 4-2 tactic for different variables. The main one being the number of goals scored from the opportunities given. Another variable was the position of where the shot came.

1.4 Limitations

- The footage was not filmed by the researcher so it may not necessarily focus on the elements of the game needed for the data collection.
- The camera angles did not cover the whole of the pool so some of the clips missed some areas of play. When collecting the data, parts of the matches were missing due to replays or camera angles not following the ball. It made it difficult to accurately record the location of the ball and players. Therefore, this affected the results slightly as the data collection commenced when the footage was back to live play.
- Due to the matches being televised live, some sections were missed during the match due to slow motion replays such as a goal being replayed or showing coach's reactions.

- The number of male matches was different to the number of female matches so when comparing males against females, there is an unfair advantage. Eight male matches were provided by FINA and only seven female matches. During the males competition, there was a total of 164 man ups given to the attacking team. The females were only awarded 125 man ups. To overcome this the data was normalised

1.5 Delimitations

- Elite players were used for the study.
- Analysis was carried out by one person which increases reliability as misinterpretation of operational definitions is reduced.

CHAPTER 2
LITERATURE REVIEW

Chapter 2: Literature review

2.0 Introduction

Previous literature has discovered that the man up in the attacking team plays an important part in the difference between winning and losing a match (Mirvic, Kazazovic & Alekandrovic, 2011). However, this research did not go into detail about the man up offence, it is more a generalisation of the importance of performance variables between winning and losing a match. Hughes, Appleton, Brooks, Hall and Wyatt (2006) considered the man up systems of play during power play situations but this was not related to levels of competition (Lupo, Tessitore, Minganti & Capranica, 2010), it was researched on a generalised level of play.

Ricardo, Alfredo and Gaetano (2012) established that more research needed to be carried out to find direct and general relationships to make it easier for coaches to focus their tactics on. Independent patterns may produce good results but there is no real tactic behind the setup which makes it harder to replicate (Gaetano et al., 2011)

There is no sufficient detail into the different types of shots used. A variety of shots have different success rates as evidenced by Escalante, Saavedra, Tella, Mansilla, Garcia-Hermoso and Dominguez (2012) and Mirvic et al. (2011). They concluded that action shots were most effective in scoring goals but it does not go into detail about the type of action shot used.

2.1 The sport

Due to the nature of a game situation always being different, it will be hard to replicate exact tactical and technical analyses (Lupo et al., 2010) to help define match outcomes on performance (Lupo, Condello, Tessitore, 2012). Few technical and tactical studies have been provided, within these studies the technical and tactical aspects of water polo have been mostly investigated in elite and sub elite men's matches (Lupo, Condello, Capranica, Tessitore, 2014). In women's water polo, tactical and technical aspects have been investigated in terms of outcome but this research was undertaken before recent rule changes.

2.1.1 Tactical aspects of water polo

Previous Research into notational analysis of elite men's water polo concluded that there were significant differences between formations used during different types of play (Hughes et al., 2006). The tactics teams use is dependent on the ability of the defence and the approach that they decide to use.

Tactical patterns implemented during single events were researched by Napolitano, Tursi, Tore and Raiola (2012). A statistical significant correlation was found between outcome of events and the tactical pattern used (Gaetano, Anunziata, Salvatore & Ricardo, 2012). During power play, the importance of this situation has been highlighted by Lupo (2010) as a main contributor to the number of goals scored.

A common methodology needs further developing to teach water polo through the use of tactics (Gaetano et al. 2012).

2.1.2 Technical demands of water polo

During one match, water polo players can cover an average distance of 1150m using front crawl with head up above water and below and with rapid changes of direction (D'Ercole, A., D'Ercole, C., Gobbi, M & Gobbi, F. 2013). Due to this, front crawl training is a fundamental aspect for technical refinement. Lyons, Al-Nakeeb & Nevill (2006) concluded that a high level of fitness allows players to accurately maintain the performance level in passing and shooting skills. A high level of fitness is also needed for fast breaks. As the attacker swimming with the ball at a fast pace, it is important to keep as much distance as possible between the attacker and defender to give the shooter more time to take the shot.

Shooting in water polo is an important performance variable as ultimately the winning team is the one that has scored the most goals. An important factor of shooting is the combination of ball velocity and accuracy (Abraldes, Ferragut, Rodriguez & Vila, 2012). The faster and more precise shot makes it harder for the goal keeper to save the ball and the defence to react to intercept the ball. Van der Wende, (2005) looked at the biomechanical analysis of a penalty shot, however their study also looked at tactical situations with water polo players in their analysis of the speed of the shot.

2.2 Applications of notation

Notational analysis is largely used in many team sports to report athletes actions during training and matches (Ouerui, Hssin, Franchini, Gmada & Bouhlel, 2013), it is an “objective way of recording performance, so that critical events in that performance can be quantified in a consistent and reliable manner” (Hughes & Bartlett, 2008, p.9). Its main focal point is with team sports looking at the interactions between players, movements and the behaviours of individual members of the team (Hughes & Bartlett, 2002). It can be computerised or hand notation system.

Notation analysts mainly focus on the general, tactical and general indicators which contribute to the understanding of the physiological, psychological, technical and tactical demands of sports (Hughes & Bartlett, 2002). Accurate and objective feedback is given for both quantitative and qualitative findings. Reliable analyses gives sports coaches the opportunity to give valuable feedback to the athletes on their strengths and weaknesses so they can focus their training on their weaknesses (Ouerui et al., 2013).

Game related statistics between winning and losing teams allows coaches to take match variables into account when planning for training and match preparations (Escalante et al., 2012). Notational analysis is used to quantify tactical and technical aspects of a match.

“A performance indicator is a selection, or combination, of action variables that aims to define some or all aspects of a performance” (Hughes & Bartlett, 2002, p.739) and should relate to successful performance or outcome. The best chosen performance indicators identify the strong and weak performances to feedback to the coach. They are used to define the differences between winning and losing a game (Csataljay, O’Donoghue, Hughes & Dancs, 2009). Performance Indicators can be categorised into general match indicators, tactical match indicators, technical indicators and biomechanical indicators (Hughes & Bartlett, 2002). General match indicators mainly describe and define a particular performance. Tactical indicators look at the importance of teamwork, fitness and movement. They can be categorised into a scoring indicator such as goals or nets, or indications of the qualities of performance for instance tackles or turnovers (Hughes & Bartlett, 2002). Both types of indicator can measure both positive and negative aspects of a performance.

2.2.1 Application of notation to similar sports

Systems of play represent important aspects of different team sports (Jäger & Schöllhorn, 2012). An important aspect would include a specific playing position on the field/court. Based on formations made on court, patterns of play can emerge from these different positions. These patterns are important as a base for tactics as they would need to be adapted depending on the opposition and their strategies.

Coaches prepare for training and competitions using notational analysis with the scope to improve the team and individual players performance (Ortega & Palao, 2009). Basketball has been the most analysed sport through notational analysis (Lorenzo, Gomez, Ortega, Ibanez & Sampaio, 2010). In basketball, it is suggested by Sampaio, Drinkwater and Leite (2010) that a winning teams performance is due to an improvement in decision making of players for better use of strategies and tactical choices.

When teams were uneven, winning teams demonstrated better adaptations for possession of the ball (Garcia, Ibanez, Martinez De Santos, Leite & Sampaio (2013). This meant that they reduced the assists of their opponents showing a better defensive performance. Winning teams have more fast breaks down the court in order to shoot before the defence could catch up with them (Marques, 1990). This is similar to water polo. In water polo, if the attacker gets a fast break with the ball swimming it down the pool to take a shot, it is harder for the defence to get back and catch up unless they are a quicker swimmer. Therefore faster breaks create more one on one situations with the goal keeper.

2.2.2 Applications of notation to water polo

Lupo et al. (2012) conducted a notational analysis into specific margins of victory for elite men's water polo. Tactical and technical aspects for winning and losing teams were explored. The counter attack, power play and transitions were three situations that were closely analysed. Previous research has shown how different set ups during attacking play have different results (Gaetano et al., 2012). To assess the tactical patterns, a computerised notation system was used to identify attacking situations and examine the attack pattern. Gaetano et al. (2012) discovered that there were seven different patterns used across nine matches.

Notational analysis has been shown to be an effective tool to increase knowledge for coaches of team sports (Hughes & Franks, 2004). Previous literature has looked at how man ups affect game statistics and how they play an important role in the game but these have not been broken down into different formations. Research studies into technical and tactical aspects of water polo are commonly present in elite competitions (Gaetano et al. 2012),(Napolitano et al . 2012), (Lupo, Minganti, Cortis, Perroni, Caprcanica and Tessitore 2009) but there is little research into other levels of competition.

2.3 Purpose of study

Drawing on conclusions from previous research, there seem to be several gaps in the literature. There is little research into uneven teams and the tactics used to use the extra player to an advantage. There is also a sparse knowledge into different types of shot and how prominent they are for scoring goals. To conclude the purpose of this study was to find if any of the man up tactics is more effective in scoring goals than the other tactics. The type of shot used to score the goal was also considered.

CHAPTER 3
METHOD

Chapter 3: Method

3.1 Sample

Data from the 2011 FINA world water polo championships in Shanghai will be used as a sample for this study. Emails were sent to FINA via facebook to request access to footage for some of the matches (see Appendix B). Fifteen matches were provided and came in the form of DVDs. These were the male and female quarterfinals, semi-finals, bronze and gold medal matches.

Table 1. Games used for the sample

Match	Team 1	vs	Team 2	Score
Men's Quarterfinals	Hungary	vs	USA	9-8
Men's Quarterfinals	Serbia	vs	Germany	9-4
Men's Quarterfinals	Croatia	vs	Montenegro	9-6
Men's Quarterfinals	Italy	vs	Spain	10-6
Men's Semi-finals	Hungary	vs	Serbia	14-15
Men's Semi-finals	Croatia	vs	Italy	8-9
Men's Bronze Medal Match	Hungary	vs	Croatia	11-12
Men's Gold Medal Match	Serbia	vs	Italy	7-8
Women's Quarterfinals	USA	vs	Russia	7-9
Women's Quarterfinals	Greece	vs	Netherlands	12-10
Women's Quarterfinals	Italy	vs	Australia	12-14
Women's Quarterfinals*	Canada	vs	China	7-9
Women's Semi-finals	Russia	vs	China	12-13
Women's Semi-finals	Greece	vs	Italy	14-11
Women's Bronze Medal Match	Russia	vs	Italy	8-7
Women's Gold Medal Match	China	vs	Greece	8-9

**Match Footage not provided by FINA*

A total of 15 matches were analysed within which 296 man ups were awarded. 7 of these were discarded from the sample as they were deemed to be detrimental to the results as there was no clear formation to record. These 7 man ups consisted of quick shots before any formation was set up or penalties were subsequently awarded.

Double exclusions during a man up are included within the results as one man up. When the footage did not show the countdown clock for exclusions, the duration of the man up was recorded manually using a stopwatch.

3.2 Notation System

A hand notation system was set up to look at which man up tactic was used, either the three-three set up or the four-two set up. Secondly if the team scored from having the extra player, which player took the shot, how many passes were made before the shot was taken and how long it took for the shot to be taken. The type of shot was also recorded. If the shot was not scored, was it a forced or unforced error from the player taking the shot or the defending team turning over the possession. There is an assumption (Nitzkowski, 1994) that the majority of shots taken should be taken from the top of the arc by the player in the middle because they have more space and time to control the ball. This is not always the case so it is interesting to see if the shots taken from other positions produced similar results.

The variables that will show breakdown of the match performance will primarily be the ratio of goals to opportunities. Other variables will be which tactic will be more effective in producing goals; number of passes used during the man up, duration of the man up, and whether the shots successful or unsuccessful?

The data collected will be from analysing the matches detailed above, using a table as it “allows a near immediate inspection of the results” (O’Donoghue, 2010, p.135) and it is easy to count up results. The calculations that will be made will be the ratio of goals to opportunities which can also be split into the two tactics as these are the main purposes of the study. Other calculations that are looked at are the number of forced errors compared to unforced errors as this will give the coach a skill to focus on depending on the outcome.

3.3 Pilot study

A pilot study of the notation system was conducted and to meet the purpose of the study. The pilot study see figure 3, was used for four matches to test the system and know the operational definitions and know how to use the system confidently.

After conducting the pilot study, it was concluded that the current system did not cover enough variables for a detailed enough analysis to provide a conclusion into the better man up tactic. The position of where the shot came from is not accurate enough. It was also discovered that the backhand shot was not used in a man up situation.

During some man ups, a formation was not always set, and a second man up occurred from the first. There was no clear process on how to record these. In the analysis stage, when this occurred, when a second man up was awarded, the result was noted as the formation that was used when the shot was taken.

4,2							3,3								
goal			No goal				goal			No goal					
5m (top of arc)			Other			Forced error	Unforced error	5m (top of arc)			Other			Forced error	Unforced error
bounce	BH	Lob	bounce	lob	tap			bounce	Bh	Lob	Bounce	lob	tap		
1		1	1	111		1111	1111 1	1		11			1	1111 1	
			11		1	1111 1	1111	111				11	1111	1111	
						1111	1111	11		1			1111 1	111	
11		11				111	1111		1	111			11	1111	

Figure 3. Pilot study on four matches

3.4 Procedure

Each match will be viewed using a DVD player and a recorded using a hand written notation system (Table 2). There will be a sheet per team. For the 3-3 man up the results will be written in a blue pen and a black pen for a 4-2 result. When all the matches have been analysed, the Bronze medal match will be viewed again to test reliability.

Table 2. The template for the hand notation process.

Team						
Tick/cross	passes	who	time	type	F/ UF	

Once the all the data has been collected, they will be inputted into a table (Table 3). A new row will be started for each man up.

Table 3. Match data

Team	Man up type	Where	Outcome	Type of shot	No of passes	Time
------	-------------	-------	---------	--------------	--------------	------

3.5 Operational definitions

Table 4. Operational definitions.

Variable	Definition
4-2 formation	During the man up, there will be four players near the 2m mark and 2 players nearer to 6m
3-3 formation	During the man up, there will be three players near the 2m mark and 3 players roughly along the 6m mark.
Goal	A goal was awarded by the referee(s)
No goal (unsuccessful)	A goal is not awarded after a shot.
5m	Where the yellow line ends alongside the pool to mark 5m
Bounce	A throw onto the water which will then bounce off the water into the goal
Lob	A pass/throw in the air straight into the goal or to another player's hand.
Tap	This is like a quick touch, a player will pass it in and another player can tap/ volley the ball into the goal.
Forced error	When the player with the ball is put under pressure and cannot manage to pass it on or take the shot successfully, for example the ball is turned over, is saved by the keeper or another player.
Unforced error	This error is down to the player with the ball. It is their fault they lose possession such as not having control of the ball, missing the target, making a poor pass.
Passes	The number of passes from when the exclusion is called to the player taking the shot without any interceptions from the opposition.
Who/ Where	The player or position in the pool that the shot has been taken from. See figure 1. In the introduction section.
Time	The time from when the exclusion has been called until the shot has been taken or possession has been lost.
Turnover	When the attacking team lose possession before a shot has been taken.

3.6 Statistical tests

The calculations made will be the ratio of goals to opportunities which were also split into the two tactics as these are the main purposes of the study. Other calculations looked at are the number of forced errors compared to unforced errors as this will give the coach a skill to focus on depending on the outcome and show the overall errors of performance, where the majority of the shots were taken from to show the best place that the team are scoring from. The type of shot used was also noted.

Using IBM SPSS 20, the statistics tests that were used are independent samples t-tests as the samples are independent and parametric and Mann-Whitney U tests as the data relies on an assumption of approximate normality.

3.7 Reliability

The men's Bronze medal match was viewed and analysed twice on separate occasions two days apart. This was used to test the intra-observer reliability of the study. The results are shown Altman (1991)'s levels of agreement (table 5).

Table 5. Altman (1991) Table of strength of Agreement

Kappa Value	Strength of agreement
0.81-1.00	Very good
0.61-0.80	Good
0.41-0.60	Moderate
0.21-0.40	Fair
<0.20	Poor

CHAPTER 4
RESULTS

Chapter 4: Results

4.0 Results

The results are presented in graphical and table formats and were statistically analysed using IBM SPSS 20. Data was manipulated in Microsoft Excel where graphs were also constructed.

Table 6. Summary of raw data

	Males		Females		Total
	4-2	3-3	4-2	3-3	
Number of man ups *	106	58	97	28	289
Number of goals scored from man ups	43	24	44	11	122
Number of man ups from which a goal was not scored	63	34	53	17	167
Forced errors	38	17	29	8	92
Unforced errors	25	17	24	9	75
% Goals scored from man up	40.6	41.4	45.4	39.3	
% Goals not scored from man up	59.4	58.6	54.6	60.7	
% Forced errors	60.3	50	54.7	47.1	
% Unforced errors	39.7	50	45.3	52.9	

* p<0.05

4.1 Shot Outcome

Whilst the 4-2 formation was used more than twice the number of the 3-3, the 3-3 produced more goals overall. Forced errors occurred more often than unforced errors in both formations. More than 50% of the shots that were unsuccessful were forced errors which were the faults of the team taking the man up as the ball may have been saved by the goalkeeper which suggests a poor shot was taken. The number of unforced errors was fairly high, more so in the 3-3 formation, see figure 4 below.

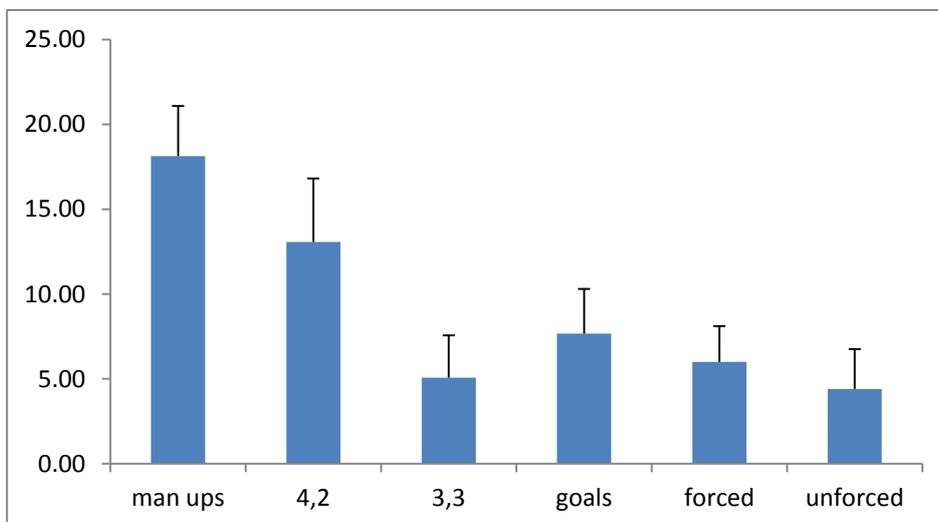


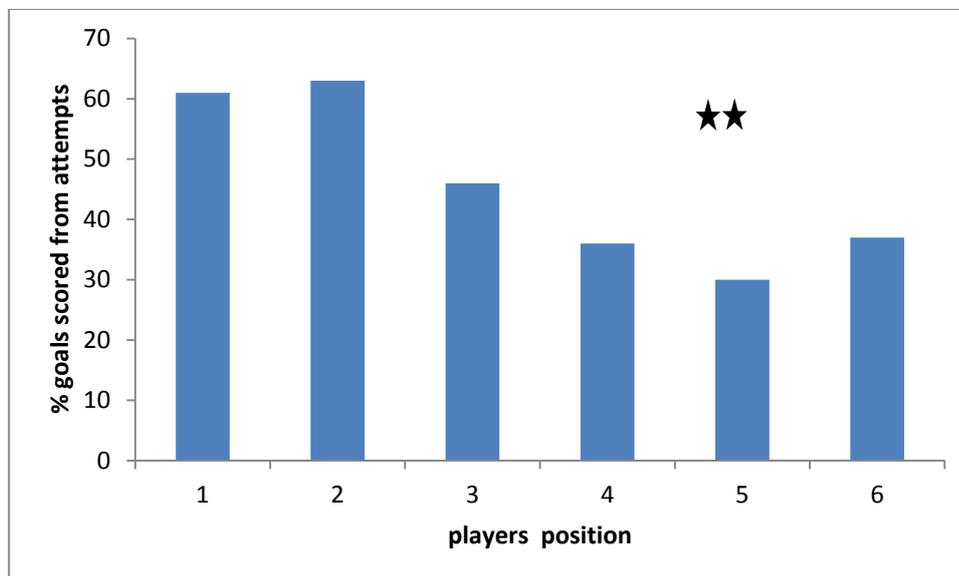
Figure 4. The mean (+SD) of man ups and outcomes per match

Figure 4, above, shows the average number of man ups and the outcomes of these per match. Per match, the formation more commonly used was the 4-2. There were more goals than forced or unforced errors per match.

Table 7. The number of goals scored from attempts at each playing position in the 4-2 and 3-3 formations.

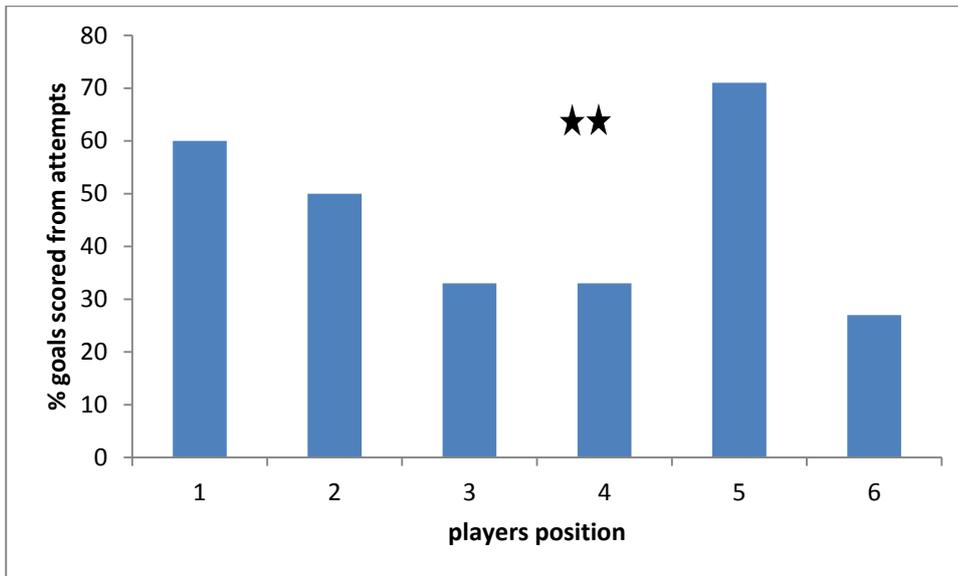
Playing position	4-2		3-3	
	Number scored	Number of attempts	Number scored	Number of attempts
1	19	31	3	5
2	12	19	2	4
3	11	23	1	3
4	19	53	9	27
5	15	50	15	21
6	10	27	7	26
Total	86	203	37	86

4.2 Position of where the shots came from



** p<0.005

Figure 5. The % of goals scored from attempts at each playing position in the 4-2.

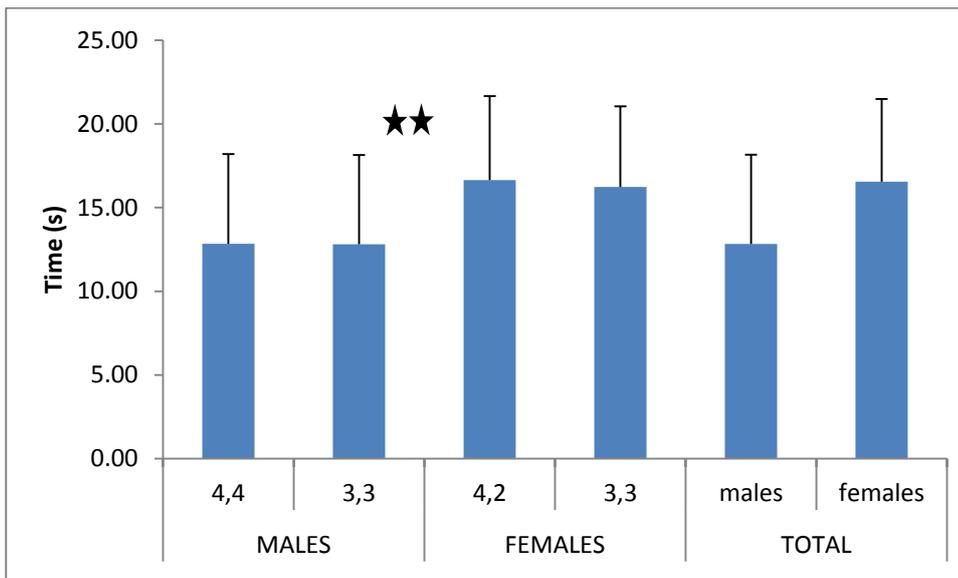


**p<0.005

Figure 6. The % of goals scored from attempts at each playing position in the 3-3.

In the 4-2 formation, the best positions that produce the greatest results are position 1 and 2 both with 61% and 63%. Whilst the majority of the shots 103/203 came from positions 4 and 5, these positions were also the least successful 30% and 36%. Positions 1 and 5 produced the best results in the 3-3 formation 60% and 71% respectively. As expected, for this tactic, the majority of shots (74/86) in the 3-3 came from the back line (positions 4, 5 and 6). However, whilst position 5 had the highest success rate 71%, 4 and 6 had the lowest (33% and 27%). Positions 4 and 6 produced the majority of shots; they were also the least successful along with position 3 (which only had 3 shots). A significant difference was found between the man up type and where the shot came from p=0.000.

4.3 Duration of man up

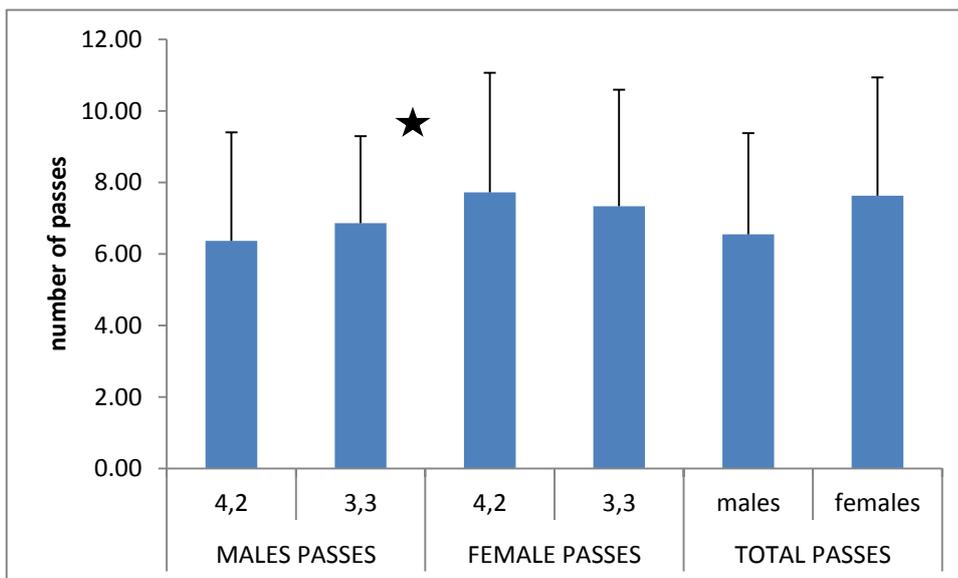


**p<0.005

Figure 7. Time for a shot to be taken during a man up for males and females

There was a significant $p < 0.005$ difference of between the genders for the time taken for the shot to be made. In the male matches, the average time shown in figure 5 is 12.84 (± 5.36)s for the 4-2 formation and 12.81 (± 5.33)s for the 3-3 formation. The average time for females was 16.65 (± 5.01)s in the 4-2 formation and 16.24 (± 4.82)s in the 3-3 formation. The average total time for males was 12.83 (± 5.33)s and for females it was 16.55 (± 4.94).

4.4 Number of passes



*p<0.05

Figure 8. Number of passes per gender man up for males and females

There was a significant $p=0.018$ difference of for the number of passes. In the male matches, the average number of passes shown in figure 8 is 6.37 (± 3.03) for the 4-2 formation and 6.86 (± 2.43) for the 3-3 formation. The average number of passes for females was 7.72 (± 3.34) in the 4-2 formation and 7.33 (± 3.26) in the 3-3 formation. The average for the total number of passes for males was 6.55 (± 2.83) and the average for females was 7.63 (± 3.31).

4.5 Types of shot

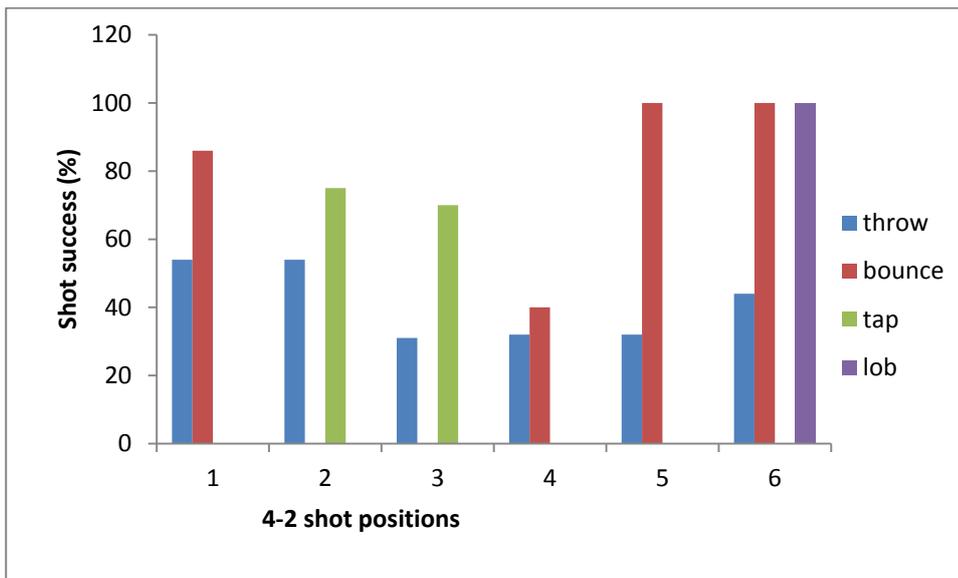


Figure 9. The % of shot success using the four types of shot from the six different positions to take the shot from in the 4-2 formation

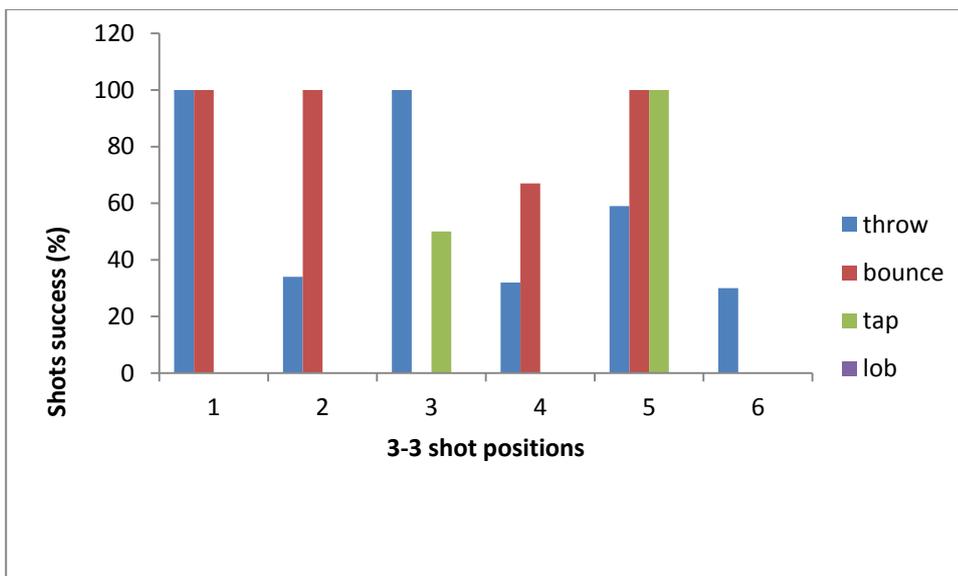


Figure 10. The % of goals scored using the four types of passes from the six different positions to take the shot from in the 3-3 formation

In the 4-2 formation, figure 7 shows the best shot to take at position 1 is the bounce shot as this proved to be 86% successful. The bounce shot deemed to be 100% successful from positions 5 and 6. The lob shot was only used four times and only one of these resulted in a goal being scored. The tap shot was most successful at positions 2 and 3 as not surprisingly these positions are closest to the goal.

In the 3-3 formation, figure 9 shows the throw shot was 100% successful from positions 1 and 3. Position 5 was 100% successful for both the bounce (three shots scored from three attempts) and tap (one shot scored from one attempt) shots. The lob was not used in any position during the 3-3 formation.

4.6 Statistical tests

Table 8. significant differences produced using Mann-Whitney U analysis.

Variables	Significant difference
Man up type and the position of where the shot came from	P= 0.000*
Gender and the position of where the shot came from	P= 0.010**
Gender and man up type	P= 0.008**
Gender and the number of passes	P= 0.018**
Gender and the time taken to have a shot on target	P= 0.000*

*p<0.05

**p< 0.005

4.7 Reliability

An intra-observer reliability test was carried out to evaluate the data collection reliability.

Table 9. Males Bronze medal match.

formation		passes		Position which took shot			time		type		outcome				
4-2	4-2	8	9	Diff	6	6	20	19	Diff	B	T	Diff	G	G	
3-3	3-3	12	11	Diff	3	3	12	11	Diff	Tap	Tap		G	G	
4-2	4-2	-	1	Diff	-	-	3	-	Diff	-	-		F	F	
4-2	4-2	5	5		5	5	16	12	Diff	B	B		G	G	
3-3	3-3	1	1		6	6	5	3	Diff	T	T		F	F	
4-2	4-2	3	3		5	4	Diff	17	13	Diff	B	B		G	G
4-2	4-2	6	7	Diff	5	5	15	8	Diff	T	T		G	G	
3-3	3-3	9	8	Diff	6	6	19	19		T	T		G	G	
4-2	4-2	7	6	Diff	1	4	Diff	18	14	Diff	T	T		G	G
4-2	4-2	6	5	Diff	5	4	Diff	17	12	Diff	T	T		G	G
4-2	4-2	5	5		5	5	16	14	Diff	T	T		F	F	

The black text was the first recording of data and the red text was a second recording on a separate occasion. The blue text indicates a difference between the two data recordings. For who and type 'diff' was recorded for differences in the two sets of data. There were no differences between the outcomes or the man up type which indicates that the data collector was consistent with their understanding of what constitutes forced and unforced errors.

Kappa and weighted kappa are displayed below (table 10) for the variables which showed a difference between the two data collections.

Table 10. Kappa values.

Variable	P0	PC	Kappa	Strength of agreement
Man up type	1	0.60	1	Very Good
Outcome	1	0.60	1	Very Good
Passes	0.4	0.18	0.27	Fair
Position which took shot	0.7	0.25	0.6	Moderate
Time	0.1	0.08	0.02	Poor
Type	0.82	0.49	0.65	Good

CHAPTER 5
DISCUSSION

Chapter 5: Discussion

5.0 Introduction

The aim of this study was to analyse two formations used during a man up situations by looking at the difference performance outcomes. To do this, performance variables were identified and a notational analysis system developed. Lupo, et al. (2009) concluded that elite competitions are clearly influenced by strong performances of man ups following exclusions. Escalante, Saavedra, Mansilla and Tella (2011) conducted research into game related statistics that differentiated between winning and losing teams. They concluded that being a player up had an impact on the result of male's matches. This result was not the same for females. The different findings could be down to fewer competitive demands, less professionalism and less specialization in the area (Escalante et al., 2011). This current study showed that males had more man ups awarded compared to the females which suggest that males play a tighter game than females and are more aggressive as they are stronger and have more power which could lead to a higher injury rate in male water polo players. An injury occurs approximately every 2-3 male match compared to 40-50 in female matches (Junge, Langevoort, Pipe, Peytavin, Wong & Mountjoy, 2006).

The results from the statistical tests indicated that there were no significant differences between the 4-2 and 3-3 formations. The following section will explore further the variables within man up situations and how they contribute to the success of man up play.

5.1 Sample used

The sample used is smaller compared to previous studies. Escalante et al. (2012) had a sample of 124 matches of different stages of competition. However their study looked at game related statistics. With an average of nineteen man ups per match, was deemed an acceptable sample size to produce reliable results.

5.2 Reliability

For a successful hand notation system, the data collection process has to be reliable. To evaluate the reliability of performance variables, the level of reliability should be considered in relation to the outcome goals of the present study (Atkinson & Nevill, 1998). This was shown in table 8. To avoid inter-observer variability, a single observer collected the data for all matches. The intra-operator reliability test showed that there was a 100% agreement for the outcome of the man up and the man up formation used. This merely shows that the researcher can use their own system and understand their operational definitions (O'Donoghue, 2007). There were small differences between the data of the other variables. There was one incidence for the type of shot where there was a disagreement between a throw and bounce shot. The duration of a man up was different on all but one occasion. This suggests that the observer was not consistent in the timing of man ups.

During the data collection, parts of matches were not being shown due to replays or the camera was showing the coaches reactions to exclusions. When this happened determining where a shot came from or the number passes that had been made was near impossible unless replays of the shot helped to indicate where the shot came from but sometime the camera angles made it unclear. Therefore this could account for the differences in the two intra observer collections.

The operator's observations of the different variables were consistent, therefore demonstrating good levels of reliability. Position of where the shot was taken from and the type of shot used produced kappa values of 0.6 and 0.65. The area which had least reliability was the duration of man ups and number of passes with kappa values of 0.02 and 0.27. This was due to the footage not always showing the countdown clock of the exclusion time and the camera showing different footage.

By using a hand notation system instead of a computerised notation system, it increases the level of error within the data as there is a greater chance of human error during the phase of inputting the data. The data may have been mistyped or inputted in the wrong order. If a computerised system was used, it would have been less time consuming at the analysis stage. Each individual man up variable was counted each time for each variable by doing it by hand. This in consequence increases the level of error for miscounting.

5.3 Position of shot and shot type

This showed the biggest difference between the two formations. Hughes et al. (2006) established that 66% of the shots taken were throw shots. This is similar to the present study as the majority of the shot type used was the throw shot, although this type of shot was not the most successful.

The majority of shots in the 4-2 formation came from positions four and five which complies with Nitzkowski (1994)'s recommendations. He emphasises that the shots should come from the two players on 5m as this is where they have more time and space to take the shot. However it has been recommended by Lupo, Tessitore, Minganti, King, Cortis & Capranica, (2011) that the shots should come from the players on the two metre line as that is where the free player will be. The results of the present study showed that positions four and five produced the lowest success rate with 34% and 35%. Positions one and two produced a success rate of over 60%. The difference between success rates between the four players on the two metre line could be down to the handedness of players and closeness to goals. If the players are all right handed they will not have the ease of catching for positions three and six to take a quick shot. However this study did not collect data for the handedness of players so this can only be an assumption. The majority of shots in the 3-3 formation came from positions four, five and six. This matches Nitzkowski (1994) who identified that the free player is on top of the arc and thus where the shots should come from. However whilst fewer shots came from the 2 metre line they were more successful than positions four and six, this may have been due to the fact that the defence did not expect the shot to come from the three players on 2m and these players will only usually get the ball if unexpectedly free.

5.4 Shot outcome

Nitzkowski (1994) p.29 believed that "a team's success is more influenced by its ability to play defence than by any other aspect of the game". Hughes et al. (2006) revealed that 57% of possessions ended up with a shot being taken, however 39% of these were unsuccessful but there is no detail into why the shot was unsuccessful. The defence play a major role into the success of a shot so the current study split the unsuccessful shots into two categories: forced and unforced. It was found that 58% of man ups given did not result in a goal being scored. The present study showed that the number of forced errors were higher than unforced errors for both formations.

This indicated that these errors were down to the defence putting pressure on the attackers and the ability of the goalkeeper and other defenders in saving the shots. An area for future research could be to look at the defending strategies during a man up to see how their tactics may change.

5.5 Duration of man ups and number of passes

Regardless of which formation the attacking team decide to use, the most important element is to get the ball moving quickly and efficiently. The attacking team can disorientate and exhaust the defenders and goalies by making them work for all 20 seconds before getting the shot away. The quicker the formation is set up, the more time they have to pass the ball around or take a shot. This is also essential to a successful man up situation.

The average time of possession of the ball during a man up is almost double the time compared to when the teams are in even play (Hughes et al., 2006). The duration of the man up and the number of passes are closely related to each other. Appleton (2000) found that 83% of the total possessions lasted 5 passes or less. This wouldn't be the case during a man up situation as the attack would be able to hold the ball for longer to tire out the defence. Hughes et al. (2006) had the assumption that more goals are scored from short durations with the ball or a low number of passes. This is true to some extent as the defence will not always expect a quick shot so occasionally they are good to use. The results from the data collection displayed that this is the case as the quick shots were successful; however, as this was a study of set formalities, these were excluded from the results.

In previous research, the average number of passes during a man up was 5.9 (Hughes et al., 2006). The present study showed that males made an average of 6.57 passes and females 7.47 passes which is slightly higher than previous research. The rules changes may have also have had an impact as the duration of exclusion has changed from 35 seconds to 20 seconds.

Lupo et al. (2010) concluded that a man up does not influence match outcomes in terms of average duration of actions, turnovers and types of shots. This suggests that durations of actions are unaffected by man ups compared to even play.

However within their study they found that the ability to efficiently perform quick dry passes and shots on goal determined one of the main differences between winning and losing teams.

5.6 4-2 vs 3-3

During man ups, occasionally a team would start in the 3-3 formation and then revolve into the 4-2 formation and vice versa. This gives the attacking team more time and space as it confuses the opposition and, by the time they have realised, the shot may have been taken, as the defence can lose track of what is happening in the water. The defence are often at their weakest and least organized in the seconds immediately following the exclusion (isport, 2014). The benefit of revolving the formations is to disorganise the defence, who are already one player down. Doing this successfully can lead to a wide-open shot on goal. In the analysis stage, when this occurred, the result was noted as the formation that was used when the shot was taken.

The 4-2 formation has been shown to be the most common set up and the current results also found this was the case, with 70% of the man ups using the 4-2 formation. Hughes et al. (2006) found that 97% of man ups were in the 4-2 formation and these produced a 36% success rate. The present study found a 42% success rate for the 4-2 formation. However, Hughes et al. (2006) conducted their study using male water polo players compared to this study with uses males and females.

5.7 Implications of results

Analysis of results represent a tool for a coach so they can base their team training sessions on the aspects of tactical formations that showed weaknesses (Ricardo, Alfredo & Gaetano, 2012). It is important to efficiently train for both formations as the results indicated that there were not any statistical differences between the 4-2 and 3-3. By training for both, the attacking team have the option of which formation to use dependant on the defence and can mix it up to confuse the defenders. If they used the same formation each time, the defence will react quicker.

Man ups are a common occurrence during a match so the formations and techniques should be executed to a high level. This suggests to coaches that they need to organise specific training sessions to incorporate the different scenarios that both the attack and defence may face during a man up (Lupo et al., 2011).

Shooting capabilities should also be worked on during training as there were many unforced errors which can be avoided and could have an impact on the game should these be turned into successful goals.

Notational analysis highlights the actual demands of a game (Lupo et al., 2011). Findings can urge coaches to improve player's abilities and capabilities to quickly handle the ball which is the most important skill of a man up because as soon as the ball is dropped, it is likely possession will be lost and the chance of scoring from a man up is then reduced (Lupo et al., 2011). Both technical and tactical aspects of water polo should be considered by coaches.

CHAPTER 6
CONCLUSION

Chapter 6: Conclusion

6.0 Conclusion

To summarise, the aim of the study was to evaluate differences between the 4-2 and 3-3 formations to see if there is a difference between man up variables in each formation. The results showed that there was a statistical difference between the man up type and the position of where the shot came from $p=0.000$. More statistical differences were found between genders and man up type ($p=0.008$), number of passes ($p=0.018$) and duration of man up ($p=0.000$). No other statistical differences were apparent between the 4-2 and 3-3 formations.

The current study concludes that whilst the 4-2 formation was used more than the 3-3, there was a difference of 1% in success rate of the number of goals scored from attempts for each man up type. The most successful position to take the shot from in the 4-2 formation is position 2, see figure 1. Position 5 is the best for the 3-3 formation. Females spend 2.98 seconds longer to take the man up shot and 0.91 more passes than males.

6.1 Further Considerations

6.1.1 Handedness of players

The handedness of the player would show the ease of catching. If they are right handed and are restricted to being on the right handed side of the pool, the ball has to come across the body in order to catch it whereas if they were left handed on the right side they can catch and throw in one. To overcome this, the team would need both left and right handed players. Research in this field could further break down this current study into the handedness of players and where the shots came from.

6.1.2 Defence strategies

Although this study focused on the attacking during a man up, defence strategies did briefly show up. Defenders did not always tightly mark during a man up taking the pressure off the attacker. The reason for this is unknown and could be further explored. However, this was not in enough detail to have an impact on the results.

If the shot outcome was negative, it was recorded if the error was forced or unforced. Forced errors were down to the strength of the defence and accounted for more than half the errors.

Therefore the strategies from the defence could be considered to see how they can further improve tactics used when they are a player down depending on whether a 4-2 or 3-3 formation is being used.

6.1.3 What area of the goal the is the shot thrown at

Further to the shot outcome, the goal could be split into sections to see where the majority of shots are aimed for at the goal. Research could be undertaken to see if there is a relationship between where the shot came from, the type of shot used and the area of the goal that the ball is aimed at. This would be useful for goalkeepers as they would have an understanding of where the majority of shots go and they can train to improve their ability.

6.1.4 Different levels of competition

Further research could be undertaken to analyse whether there is a difference between the different levels of competition. Teams in quarterfinals might play a different attack strategy for the man up compared to the strategies they play in a gold medal match. The defence strategies could also be analysed.

6.1.5 The pattern in which the 4-2 and 3-3 are used

A pattern may occur for when the 4-2 and 3-3 are used. The 4-2 might be used all the time by one team or a combination of both formations. If a combination is used, it will take the defence longer to react as they first have to work out which formation is being used, whereas if the 4-2 is always used the defence could react quicker. Combinations used were 4-2 merging into a 3-3 or vice versa. By merging into the other it gives the attack more time and space to take the shot as the defence need to alter where they are positioned.

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Appendix A: Ethic Status

Date: 11 March 2014

To : Chloe Laister

Project reference number: 13/05/207U

Your project was recommended for conditional approval by myself as supervisor and formally approved at the Cardiff School of Sport Research Ethics Committee meeting of 26th June 2013.

Yours sincerely

Ray Ponting

Appendix B: Contacting FINA for footage

