



Demands/Capacity analysis for water polo

A short overview on international water polo and Swedish level in 2006

Bogdan Anastasiu Chivaran

THE SWEDISH SCHOOL OF SPORT
AND HEALTH SCIENCE
Träningslära VFU: Okt/2006, second year of study
Handledare: Mårten Fredriksson and
Lee Nolan

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Attachment 1 - Sources and literature searching.

Demands profile

Introduction

This essay is a moment in a Theory of the training course on The Swedish School of Sport and Health Science in Stockholm. Meaning with this work is to create or rather to establish a demands analysis (profile) for water polo at international level and then match it with the existing profile in Sweden. Very few studies and profiles were made public regarding elite water polo players. A thought behind it it's that every trainer wants to keep the secret of the training and performance in order to get best result.

Another reason for this essay is to be a beginning in the effort put by Swedish swimming association together with the Swedish Olympic Committee and I to bring Swedish water polo again on the top chart in the next years and to ensure a qualification for the Olympic Games in 2012 and/or 2016.

In this chapter of the essay I will concentrate more on all the demands that are required for being accepted as an international elite water polo player. Physical characteristics (anthropometric characteristics), psychological demands and physiological characteristics will be analyzed in this chapter.

Background

As Sweden heads towards the Olympics in 2012 an exact knowledge of the elite water polo level is required. That's why this essay is addressed to the senior level or a bit further to the national team level.

Limitation

Sweden was a country that had a tradition in water polo. Because unknown factors the interest for water polo in Sweden decreased dramatically after the end of 1960s. Year 2006 finds Sweden with a low level in water polo, where is most likely to describe water polo level as amateur level. This is why this work will more concentrate on the international level. All data is taken from countries with top level in water polo.

Aim

The aim of this overview is to describe the level that an elite performer has nowadays and to give a suggestion on the future training for the Swedish team.

Method

In order to accomplish the target I gathered information from different articles existing. A search on databases as PubMed and Sportdiscus gave very few results that I could use in this matter. Details on the searched words are given in the attachment regarding this matter. Another guide I found in the book “Physiological test for elite athletes” by Gore C.J. Not at last I used my experience as a trainer to complete the task.

Results

International level:

- The elite performers are strong psychologically in order to endure the pressure of the game and public
- Top performers have high intellectual level
- A fast ability in understanding a situation and find the solution
- Players possess a quite high physical strength and endurance in order to perform in game
- Most of the players are ready and able to play the whole match without serious consequences as a result of the effort
- Very tactical and a very good technical execution
- The top performers train usually between 6 and 9 hours a day, five days a week.
- The competition schedule gives the players chance to only 2 weeks rest every year in the beginning of September for national team’s players and 2 weeks in summer for club players
- National team’s players train together every day, 2 times a day, five days a week about 4 hours each practice
- High educated trainers and motivated for their job
- Very large selection area including all ages and levels
- Anthropometrical characteristics of the elite players: age 25 ± 5 years, height 184.5 ± 4.3 cm, body mass 90.7 ± 6.4 kg, body fat $16.8\pm 4.4\%$, lean mass 75.1 ± 4.9 kg.¹
- Different capacities have been tested and registered: VO₂ max 4.9 l/min (vo₂max 57.1 ml·kg⁻¹·min⁻¹); Peak HR 193 beats/min; Peak power 447 W. Strength: maximal explosiveness 110N, repeat expl. -8%, 3RM bench press 97.08kg, 3RM leg press 242.5, 3RM chin-ups 21.25kg, MR bench press 16.7reps, MR leg press 18.6 reps²

¹ Yiannis E. Tsekouras, Stavros A. Kavouras, Alessandra Campagna, Yiannis P. Kotsis, Silia S. Syntosi, Kalomira Papazoglou, Labros S. Sidossis, *The anthropometrical and physiological characteristics of elite waterpolo players*, Eur. J. Appl. Physiol (2005) 95: 35-41, DOI 10.1007/s00421-005-1388-2

² Gore, C.J., *Physiological tests for elite athletes*, Champaign, III: Human Kinetics, 2000. ISBN 0736003266, page 418, Table 30.6, resp. page 421 table 30.8

Sweden:

- Not that strong psychological
- Not all players are university attendants
- Due to short amount of trainings there is a lack in ability to understand and resolve sudden situations
- Few with good technical qualities
- Not that good physical shape: quite low physical condition
- No tactics almost except few clubs that have the benefit of foreign players
- Swedish players train maximum 3 times a week about 2 hours each practice.
- Almost no international matches
- Free time without any practice: from the end of May to the beginning of September
- National team gathers 2 times a year for one weekend
- Almost no special education for trainers and most of them have it as a second job
- Not to many players to choose from, very few interested of water polo
- No anthropometrical characteristics or physiological capacities have been tested for Swedish players

Discussion and conclusions

A big and easy to notice difference is observed between the levels of elite and Swedish team. The difference is this big because of the level that water polo has in Sweden. Reasons for this are unknown. Lars Fjærstad names that after de 1960s the East European countries have begun to make water polo a more professional sport³, while Sweden kept its ideal role for health and fun.

Water polo is a popular and highly demanding sport.⁴ The necessity of studies in this domain starts growing. More and more structures are involved in developing the sport. One of the efforts that are made is to start creating a profile for the elite performer in water polo as a model to reach for the trainers and performers in Sweden. A big problem in Sweden is that none of the active trainers are educated in this way and they possess few or no knowledge in training “art”.

Still tests have not been made to establish which the start level for actual performers is. An intensively effort is made now to accomplish this task which is strongly needed. Without a model and an actual level, a progress can never be made.

Tests for elite athletes are still perfected and new methods to make field tests easier are developed.

My opinion about actual testing of elite athletes is still divided between test methods. While for LT and AT I agree with the methods, regarding VO₂max and some of the strength tests I still have question marks. Gore C.J. talks in his book “Physiological tests for elite athletes”

³ Lars Fjærstad, ”Poolen fylld med polo i 100 år!”, Simsport, 1999-2000, pp.28-30

⁴ Farajian P., Kavouras SA., Yannakoulia M., Sidossis LS., 2004, *Dietary intake and nutritional practices of elite Greek aquatic athletes*, International Journal Sport Nutrition Exercise Metabolism 14:574-585.

about the fact that there is no standard test of maximum oxygen consumption for water polo players, just occasionally tests have been made using ergo meters.⁵ Such tests in my opinion are not highly relevant due to the environment of use and position in which the subject performs the test. The isokinetic tests for shoulders strength⁶ is in my opinion not very relevant for the total effect of a shot as in the shot movement are involved more body structures that add an affect on the final shot. In plus such tests have a risk for injury. It is better to use these tests for testing the recovery process after an eventual accident.

Suggestions/plans for the next period until OS in order to stand a chance:

- A good selection in national team trainers with high competences in training
- More time in the water: best would be that both clubs and national team to be able to train every day. For the beginning I suggest an increase in training hours from 6 a week to 10. That means 2 hours of training every day in the next 1 year. Further a possibility to train six days a week if no matches in the weekend
- For the national team a chance to meet every month for the next 2 years and then little by little to train every day
- More time should be spent on technical execution training and tactics of the game
- A planed training with the aim before established would be an important document for the trainers. If the trainers need they should be able to ask special competence in order to test their players and find the optimal training methods
- Due to the low amount of matches at least 2 training camps should be organised every year in countries with high level in water polo

Final conclusions that should be remembered would be:

1. Creating a specific test battery that can give more relevant data in all capacities.
2. A better result can be obtained when specialised trainers and trainings are used.
3. A bigger volume for training is required
4. A larger selection base is required
5. New trainers should be educated and more competence is required.

One more thought that is worth talking about is that on elite level it is also important to talk about teams demands. This is because in this team sport small “handicaps” of the individual players can be covered up by other qualities or the other members of the team.

⁵ Gore,C.J., *Physiological tests for elite athletes*, Champaign, III: Human Kinetics, 2000. ISBN 0736003266, page 416

⁶ Yiannis E. Tsekouras, Stavros A. Kavouras, Alessandra Campagna, Yiannis P. Kotsis, Silia S. Syntosi, Kalomira Papazoglou, Labros S. Sidossis, *The anthropometrical and physiological characteristics of elite waterpolo players*, Eur. J. Appl. Physiol (2005) 95: 35-41, DOI 10.1007/s00421-005-1388-2

Capacity analysis

Introduction

This part of the essay is also a moment in the Theory of training course on The Swedish School of Sport and Health Science in Stockholm. In this part I will try to summarise and describe tests that are used by trainers to measure or to determine the level of the players at a specific moment in the training plan. It is very important for trainers and for players to use these tests as a guiding line in future training.

Background

Since sport as we know today was born, different measuring or tests were also born to see/measure the level of the performer and compare to another in order to determine how much should and how should the performer train for gaining the victory. As so the tests were meant for the elite athletes. This is why I will refer here at tests used for elite players in water polo.

Limitation

Normally I should refer here in tests conducted in Sweden for the players. As told earlier, due to the amateur level for water polo in Sweden, no tests are driven or taken for Swedish water polo players. Only one test I witnessed in Sweden and will be taken in discussion in the essay. For this reason I will describe tests used in other countries there water polo has a professional level.

Aim

The aim of this work is to reveal what tests are available today and also used in elite activity for measuring different capacities.

Method

Again, the method I used to find information is by data bases searching. More help was found in our course literature. An attachment with more details for searching word and which databases I used will be attached to make eventual searching possible for the reader. More

information I used is obtained from earlier studies I had. For finding out something about Swedish testing I asked again the person responsible for water polo in Sweden but the answer was a question, as there is now testing for player in Sweden.

Results

Anthropometric and body composition

Conventional procedures are used to determine weight and stature according Gordon (1988) with an error of 0.1 kg and 0.5 cm respectively. The usual formula for BMI was used: $BMI (kg \cdot m^{-2}) = Wt (kg) \cdot [Ht (m)]^{-2}$.⁷ Different equipment can be used to determine FM and LM as well BMD according to the possibilities existing in the laboratories.

Aerobic testes and lactate threshold

The most usual test is the 200m repeat swims. Information given in first hand by the test is from graphs of heart rate against time and further lactate against time. This test is meant to be an indication of the aerobic capability. Obtaining same time with lower HR and lactates would show improvement in this capability. The swims are performed on a 6 min cycle. HR is recorded right after the end of swimming with the subject in the water in an upright position with preferably a Polar HR monitor. After, the player leaves the pool for blood sample. That can be taken with the player seated from earlobe or fingertip. The player must return in the water and it is indicated for him/her to swim some meters to recover. The steps described in the test are: 1 step 70% of personal best time (pb+30s), step 2 80% (pb+20s), step 3 85% (pb+15s), step 4 90% (pb+10s), step 5 100% pb. After, a 15 min rest including 500m easy swim is indicated. Goal keepers perform a 3 times 200m breaststroke with steps: 75%, 85% and 95% of personal best time.⁸

Lactic and anaerobic testing

The test consists in 4 times 50m with a 10 s rest in between. Blood samples will be taken right after the swim as described in the test before at times 1, 3, 5, 8 and 12 min after exercise with rest in sitting position. Another day the players will swim a 30m distance in order to monitor the lactic anaerobic metabolism. The distance is divided in five using landmarks. Time will be registered each time the top of the head reaches the line of the mark. Hand timing can be used.⁹

^{7,9} Yiannis E. Tsekouras, Stavros A. Kavouras, Alessandra Campagna, Yiannis P. Kotsis, Silia S. Syntosi, Kalomira Papazoglou, Labros S. Sidossis, *The anthropometrical and physiological characteristics of elite waterpolo players*, Eur. J. Appl. Physiol (2005) 95: 35-41, DOI 10.1007/s00421-005-1388-2

⁸ Gore, C.J., *Physiological tests for elite athletes*, Champaign, III: Human Kinetics, 2000. ISBN 0736003266, page 413

Speed and endurance tests

The classical one repetition of 100m freestyle (breaststroke for goalkeepers) max. HR is registered right after the swim and an earlobe blood sample is taken.¹⁰

Sprint tests

4×25m with a 3 minutes rest interval between swims¹¹:

1. 25m freestyle starts inside the water. 2 attempts at max effort.
2. 25m freestyle – arms only with no wall push
3. 25m freestyle kick – no push from the wall
4. 25m eggbeater kick - no push from the wall
5. 25m breaststroke kick(only goalkeepers) - no push from the wall

VO2 max

No standard tests are described for water polo players. Earlier tests used an arm-leg ergometer in the lab or tethered swimming in the pool.¹²

Another method is the one suggested by Costill (et al. 1985), Lavoie (et al. 1983), Montpetit (et al. 1981). Post expiratory gasses are analyzed to calculate the VO₂ in a 400m freestyle bout. Subjects must exhale the last breath into a breathing mask after it was fitted over the head. Metabolic values of VO₂ determined by averaging the final 20s¹³. Hr is registered right after the swimming with a Polar HR monitor.¹⁴

Strength

Most common test is probably the inside and outside isokinetic rotation of the arm described also by Yiannis E (et al. 2005). The arm is in abduction at a 90° angle.¹⁵

Gore J.C. tells in his book “Physiological tests for elite athletes” that research shows a context specific adaptation of the strength inn waterpolo.

More strength tests for water polo players are: 3RM chin-up, 3RM bench press, 3RM leg press. These tests measure maximum strength by using heavy weights. Same tests can be used

¹⁰, ¹¹, ¹² Gore, C.J., *Physiological tests for elite athletes*, Champaign, III: Human Kinetics, 2000. ISBN 0736003266, page 413-414

¹³ Costill D.L., Kovaleski J., Porter D., Kirwan J., Fielding R., King D., 1985, *Energy expenditure during front crawl swimming: predicting success in middle-distance events*, Int J Sports Medicine, 6:266-270

Lavoie J-M., Leger L.A., Montpetit R.R., Chabot S., 1983, *Backward extrapolation of VO₂ from the O₂ recovery curve after a voluntary maximal 400-m swim*, In: Hollander A.P., Huijing P.A., de Groot G., (eds), *Biomechanics and medicine in swimming*, Human Kinetics, Champaign I.L., pp 222-227

Montpetit R.R., Leger L.A., Lavoie J.M., Cazorla G., 1981, *VO₂ peak during free swimming using backward extrapolation of the O₂ recovery curve*, Eur J Appl Physiol Occup Physiol, 47:385-391

¹⁴, ¹⁵ Yiannis E. Tsekouras, Stavros A. Kavouras, Alessandra Campagna, Yiannis P. Kotsis, Silia S. Syntosi, Kalomira Papazoglou, Labros S. Sidossis, *The anthropometrical and physiological characteristics of elite waterpolo players*, Eur. J. Appl. Physiol (2005) 95: 35-41, DOI 10.1007/s00421-005-1388-2

for strength endurance tests only that weight must be 70% of the body weight. Only bench press and leg press will be tested.

Isokinetic tests have started to be used also in the natural environment for the water polo players as there is a significant difference in the effort on land and in water.

In water tests as Gore C.J. describes can be for maximal explosiveness or repeat explosiveness.

Maximal explosiveness:

The athlete must perform a vertical jump. A belt is worn by the athlete that is connected to a dynamometer. A 10 N load is the dynamometer that is thought to act to the partially the vertical movement of the performer. Peak force and power are recorded for each player.

Repeat explosiveness (only for field players):

A 30s trial during which the player performs 15 jumps at an interval of 2s in between. Same values will be registered.

Note: All athletes were informed about the protocol of the tests before testing and training was reduced one day before testing. They were advised to maintain their usual carbohydrate rate and to be well hydrated all this time. Every test was performed in a different day such as 2 tests didn't take time in the same day.

Discussion and conclusions

All kinds of tests have been available since the beginning of professional water polo. Most of the tests were still discovered after the communist systems fell in the eastern European countries there special activity was conducted in this direction.

Test batteries continue to be improved and created in order to match the existing reality. All tests presented here proved to have high validity and reliability.

A short commentary I would like to add is about the isokinetic test for the shoulder. After having the occasion of being tested in this matter as an elite player, I would say that the test is kind an uncomfortable and in the same time presents a high injury risk. Others say that it is good for measuring the progress made after a recovery period but my question mark remains there for a while. In this matter I think it depends of the injury level, when lot of the flexibility can be lost. Further the result gives a partial information and not that relevant. In water the situation and the possibilities to execute a movement are very different and the total power that is interesting for the shot is determined by more muscles and body components involved in the act.

One thing missing is a possibility of direct testing. And I mean with this a way to measure all capabilities and capacities during an official game. Not even a training match is easier because of the specific of this sport where near contact and some time fight (wrestling) is a permanent fact.

Regarding what type of equipment is used to measure can be said only that depends of the laboratory and the resources of the club. What is important is that the equipment should be precise and have a good validity and reliability.

Conclusions:

- International water polo activity has a very structured and precise method to use in guiding the training process
- A continuous effort is made to find and adapt tests in order to match the reality
- There is no way yet to measure different capacities or capabilities directly during a match

References

1. Costill D.L., Kovaleski J., Porter D., Kirwan J., Fielding R., King D., 1985, *Energy expenditure during front crawl swimming: predicting success in middle-distance events*, Int J Sports Medicine, 6:266-270
2. Farajian P., Kavouras SA., Yannakoulia M., Sidossis LS., 2004, *Dietary intake and nutritional practices of elite Greek aquatic athletes*, International Journal Sport Nutrition Exercise Metabolism 14:574-585.
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Attachement 1

SOURCES AND LITERATURE SEARCHING

What?

Words	Synonyms
<i>Water polo</i> <i>Anaerobic threshold</i> <i>Aerobic capacity</i> <i>Anthropometric</i> <i>Lactate</i> <i>Profile</i>	<i>Här anger du vilka synonymer för ämnesorden du har använt.</i>

Why?

<i>I chose this words as I think they were representative for my subject</i>

How?

Data base	Searching combination	Results	No for relevant results
<i>Sport Discus</i>	<i>First I went for the word water polo that actually gave me the best searching base. Then I tried to combinate the word with diffrent other words mentioned above. Most results I got to chose from after the word water polo.</i>	<i>1266 then results between 4 to 21</i>	
<i>Pub Med</i>	<i>Same tactic. I used then water polo and anthropometric.</i>	<i>120 and then 2</i>	

Comments:

<i>I would like to add that in searching, after I used the word water polo and got all those results I started looking only for full text results. I also used for this task own articles that I had before.</i>
