

Environmental Success Factors or the Justification for the Prohibition of High-Tech Swimsuits in Swimming

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ABSTRACT

The scope of the study was to elaborate and represent different aspects of high-tech suits which influence the swimming results and to justify the change of swimming rules in 2009. Impact of environmental factors on the result should not be greater than the athlete's impact. Impact of high-tech suits greatly contributes to the development of technology, new materials and modern design of sports equipment. The paper describes the genesis of the high-tech swimsuits and provides an analysis of causes and consequences of its prohibition. The arguments against the suits have an effect on prohibition of different sports requisites and equipment in all sports. This prohibition directly affects the modern swimmers who will have difficulties in breaking the world records swimming in high-tech suits.

Key words: sports equipment, swimming performance, fair play

Introduction

There is a range of anthropological components that contribute to successful performance in sports: motor skills, genetic potential, energetic capacity, mental and psychological skills. However, more often than not environmental factors as well as sports equipment are the least important factors in this list. Regardless of the above mentioned order, sports equipment plays an important role in some sports such as boulders in formula racing or boats used for the America's Cup. The development of technology, new materials, the modern design of sports equipment have forced the sports people to find a balance between the sports equipment that is allowed and prohibited in sports.

This problem has to be analyzed seriously since numerous scientific studies have dealt with the topic. For example, the tennis racket which is designed in order to absorb the vibrations caused by the impact at maximum level enables the player to hit the ball hard without facing the danger of injuring the hand¹. In football the design of the ball (Cafusa, Jabulani, Brazuca) has an effect on air resistance and on trajectory of the ball which can lead to more scores if the flight of the ball is unpredictable to a goal keeper².

The question that raises many doubts concerns the fairness or unfairness of Pistorius's prosthetics in respect to other athletes³.

In some cases the effect of sports equipment has been minimized. The runner Zola Budd who mainly trained and raced barefoot was winning marathons and ultra marathons. Sprint shoes can have a negative effect on the energetic capacities during long distance running. The effect of sprint shoes is undoubtedly higher in short distance running because of friction and ground reaction⁴.

The above mentioned examples underline the complexity of the problem as well as the moral dilemmas related to the topic. Should the sports equipment of the new generation be equalized with the doping? There is no universal answer to this question. For instance, the football ball is the same for all the players on the field while some tennis players may have a high-tech racket and the others may not.

During the history there has always been controversy related to sports equipment. In the 1990s Bloomer's swimsuit was designed in accordance to the needs of modest society of that period. Australian swimmer and fashion

icon Annette Kellerman (world record in 100 m: first woman to swim the English Channel) was arrested in Boston in 1907 because she wore a controversial one piece, form-fitting body suit revealing her legs⁵.

On the court Annette said that wearing a Bloomer's swimsuit means wearing more clothes than there is on the dryer. People were aware of the fact that the swimsuit had an effect on swimming performance even 120 years ago. However, the swimsuit was scandalous because of moral convictions that exist even nowadays in some cultures⁶. In the 21st century the swimsuit is controversial because of its effect on the swimming result. In the 2009 the international swimming federation FINA issued a clarification of the swimming rules and restricted the dimension of high-tech swimming suit.

The genesis of the swimsuits in relation to the material is the following: wool, cotton, silk, nylon, lycra and the products based on polyurethane⁷. The new high-tech swimsuits have appeared for the first time at the Barcelona Olympics when Speedo launched the model S2000⁸. The S2000 was followed by Aquablade in the 1996, then Fastskin in the 1999 which resembles the shark's skin. In the 2004 Fastskin FSII was launched, then FS-pro model in the 2007 and in the 2008 LZR racer as the last swimsuit before the clarification of new rules.

There are different models of Speedos which cover different body parts: the model from waist to knee, from waist to ankle, from shoulder to ankle and the model covering the whole body. These models adjusted to different trends that changed during the years. The models were different for each swimming style⁹. Since the 1990s due to the development of swimming suits the Olympics in the 2000, the 2008 and the 2009 resulted in medals. Afterwards the rules have changed and the swimming results have decreased by 2%³. In the 2009 forty-three world records have been broken. During the World Championship 2009 which took place in Rome, 15 records in men's competition and 17 records in women's competition have been broken. There were twenty disciplines overall. Three years later there were 14 records in men's and 17 records in women's competition¹⁰.

The scope of the study is to represent and elaborate the influence of high-tech swimsuits on the swimming results and to justify the prohibition of swimsuits by clarification of new rules in the 2009.

Discussion

The development of new technological areas such as atomic physics, computer science and nanoscience contributed to the emergence of new materials such as polymers or metal alloys, especially carbon fibers which have been widely used in sports³. The studies have shown that the materials used in swimwear manufacturing such as polyamide6 (nylon), polyamide6-elastan (nylon-lycra or polyester) have a great effect on the result¹¹. Water athletes have an uneven skin tone which enhances the water resistance.

In the past swimmers used to shave off their body hair but the problem of the uneven skin tone such as pores and musculature remained unsolved. The problem was solved by introducing the speedo models S2000 and Aquablade which covered almost the whole body and were based on different studies. These studies proved that the skin friction in water can be minimized by wearing a swimsuit that covers the body from shoulder to waist¹². Bionics is the application of biological methods and systems found in nature to the study and design of engineering systems and modern technology.

The application of bionics played an important role in manufacturing swimsuits that resemble the shark's skin. The shape and structure of shark's scales enhance water circulation and minimize circulation of turbulent fluids and water resistance¹³. Special fabric reinforcement on some body parts compress these body parts lifting their surface, that is creates aerodynamic force (especially on backside or women's breasts). The body deformation caused by the compression of the swimsuit effects the swimming speed.

The compression technology gives the swimsuit a seamless tight, fit. It has an effect on water resistance and decreases the size of air pockets¹⁴. The compression also decreases muscular oscillations and skin vibrations¹⁵. It is important to mention that the swimsuits have a greater effect on the result of skinnier people¹⁶ because skinny muscular body obviously represents disadvantage in comparison to body weight.

According to some studies the compression coefficient of the swimsuit has a positive effect on coordination¹⁷. Other studies show that swimsuits have an effect on technical performance and propulsive efficiency¹⁸, as well as on number, frequency and length of swimming strokes¹⁹.

Anisotropic materials have an effect on speed of hips in the dolphin's kick²⁰. According to physiological indicators hi-tech swimsuit has a positive effect on energetic demands in swimming²¹. A large number of scientific studies proved the above mentioned facts, different swimming styles are highly influenced by high-tech swimsuits^{12,13,15,22–25}.

Without scientific confirmation there are only hypothesis about the positive effects of swimsuits: swimsuit can hold many tiny air bubbles which add buoyancy; swimsuit has an ergogenic effect on swimming; the compression of the swimsuit enhances postural musculature and saves muscle energy which then increases the propulsive efficiency of the musculature¹⁹. The new rules had to be adjusted to the benefits of the high-tech swimsuits: the body has to be covered to a certain limit, material has to be made of textile fabric, material surface has to be even, impregnation and painted swimsuit are forbidden, fabric thickness must be 0,8 mm, buoyancy to 0,5 N and water-resistance to a minimum of 80 l/m²/sec.

Even though the catapult effect in pole vaulting is rather high the pole is still made of high-tech materials which are also used for tennis rackets. It would be interesting to see modern tennis players using a wooden rack-

et like Byorn Borg did. According to the basic triathlon rules the suit can cover the whole body except head, wrist and toes. It has to be taken into consideration that the triathlon wetsuit must be 5mm thick. It would be hypocritical to forbid hitech suits while high-tech bicycles are the most popular ones²⁶.

Thermoregulation is a key success factor in some endurance sports. Sport equipment made of special polyester fibres (coolmax or sports wool) has an effect on thermoregulation. This kind of equipment is not forbidden on sports fields²⁷. High-tech football boots help the running gait to be more efficient²⁸. Football shin pads made of carbon fibers instead of polypropylene help to avoid injuries²⁹. High-tech basketball shoes help the players to jump higher and land softer³⁰ and help prevent injuries³¹. According to scientific literature there is an infinite number of sports equipment that plays an essential role in doing sports. If we were to forbid the advanced technological equipment most of sports would be changed.

It is interesting to mention that the swimsuits were designed in accordance with the International Olympic Committee. The members agreed that there are different swimming fractions and different swimming resistance for each swimmer. The swimsuits are the tool in order to minimize these differences³². However, a few years' later swimsuits were forbidden because they seriously influenced swimming performance³³. The pros and cons of swimsuits are based on the same argument. On one hand swimsuits are forbidden because of the differences between the swimmers (on morphological and physiological level). On the other hand the swimsuit minimizes the differences between the swimmers (on morphological and physiological level) and should be allowed. The remaining arguments against the swimsuits are not scientifically confirmed. There are no medical implications which would forbid the use of swimsuits even though wearing the swimsuit may result in blisters and foot ulcers on toes and *interphalangeus ankles*³⁴. In a debate on swimsuits some

people were in favor of suits because they argued that the prohibition of the suits would make swimming less attractive. It can result in a less number of people watching it because they cannot see bronzed and oiled swimmer's body anymore⁸.

The prohibition of high-tech suits would not equalize the differences between the rich and the poor countries. The rich will always be ahead because of their advanced technology which will contribute to the development of sports medical laboratories or pharmacology. The sports equipment is influenced by the development of science and it is an ongoing process. The arguments which forbid the use of swimsuits can be related to a great part of sports equipment and sport aid in different sports. Swimsuit cannot be equalized with the doping because doping by its definition includes illegal substances and methods whereas the suit by its definition includes neither substances nor methods. Today's top professional swimmers are facing the risk of lower results at different competitions because of the prohibition of swimsuit¹⁰. The question is: if the high-tech swimsuits are illegal why the results achieved before the prohibition are not annulled?

Conclusion

The scope of the study was to elaborate and represent different aspects of high-tech suits which influence the swimming results and to justify the change of swimming rules in 2009. High-tech swimming suits are the top product of modern technology which helps the swimmer to adjust to water. Swimsuits have influenced the results of professional swimmers and have raised many doubts. The arguments against the suits have an effect on the prohibition of different sports requisites and equipment in all sports. The prohibition directly affects the modern swimmers who will have difficulties in breaking the world records swimming in high-tech suits.

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OKOLINSKI FAKTORI USPJEHA U PLIVANJU ILI OPRAVDANOST ZABRANE »HIGH-TECH« ODIJELA U PLIVANJU

SAŽETAK

Cilj ovoga rada bio je prikazati i objasniti aspekte utjecaja »high-tech« odijela na rezultat u plivanju te analizirati opravdanost zabrane odijela promjenom pravila plivanja 2009 godine. Okolinski faktori uspjeha u nekom sportu se često moraju regulirati pravilima kako ne bi imali veći utjecaj na rezultat od samog sportaša. Tome uvelike doprinosi razvoj tehnologije, novi materijali ili napredni dizajn pojedine sportske opreme. U radu je prikazana geneza odijela i rezultata. Analizirani su uzroci kao i posljedice ove zabrane. Odijela za plivanje utjecala su na rezultate u vrhunskom plivanju i izazvala brojne kontraverze. Argumenti zbog kojih su odijela zabranjena mogli bi momentalno zabraniti čitav niz rekvi-zita i sportske opreme u skoro svim sportovima. Ova zabrana je direktno oštetila plivače danas koji će teško srušiti rekorde postavljene plivajući u »high-tech« odijelima.