

**Presentation
of the doctoral
dissertation**

**Predstavitev
doktorske
disertacije**

**ANALYSIS OF LOADING
AND EFFORT OF WING PLAYERS
IN TEAM HANDBALL*
(Primož Pori, Ph.D.)**

**ANALIZA OBREMENITEV
IN NAPORA KRILNIH IGRALCEV
V ROKOMETU
(dr. Primož Pori)**

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Key words: team handball, loading, effort, match analysis, computer vision, heart rate, blood lactate

Ključne besede: roket, obremenitve, napor, analiza tekme, računalniški vid, frekvenca srca, laktat v krvi

Primož Pori, Master of Science in Kinesiology, was awarded doctoral degree on 29 September 2003 after having successfully defended his doctoral thesis entitled "Analysis of Loading and Effort of Wing Players in Team Handball" before the Doctoral Committee consisting of professors. He wrote his thesis on polystructural acyclic and complex sports at the Faculty of Sport, University of Ljubljana, under the mentorship of Dr. Marko Šibila, Assistant Professor at the Faculty of Sport, and co-mentorship of Prof. Dr. Stanislav Kovačič from the Faculty of Electrical Engineering.

The topic of the thesis covers an assessment of players' loading and effort in a handball game. In the past the problems encountered in analysing loading in complex games were due to inadequate and hardly accessible technology for measuring loading at competitions. In view of the fact that during an official competition it is difficult, if not impossible, to measure various parameters of loading and effort accurately, in the past the researchers applied the method of statistical recording of occurrence of individual activities in a match and the method of subjective estimation of loading. Athletes' endurance was also established under laboratory conditions, mostly by applying tests of loading in cyclic sports. Development of computer science and video technology influenced the development of new possibilities of analysing loading, primarily by using a variety of methods for tracking players during a match. The author of the thesis used measuring technology for analysing the volume and intensity of cyclic movements during a match and training which is based on the principles of computer vision.

The author structured the topic of the thesis on the basis of recent findings on energy mechanisms that are involved in the functioning of player's organism during a handball match. Knowledge on dynamics and structure of loading is the foundation in establishing the level of effort in a match while at the same time it provides important information to be used in creation of an optimum conditioning and training process. In sports games of acyclic nature the intensity and volume of loading are changing all the time, owing to which their investigation is rather complex. During

*The doctoral thesis is available for inspection at the library of the Faculty of Sport, University of Ljubljana.

a handball game cyclic types of loading such as various ways of walking and running appear in parallel to the acyclic ones such as passing the ball, shots and falls. During a match the loading appears at intervals, as a consequence of the changes in game dynamics and types of loading.

The topic and the hypotheses in the thesis are based on the recent findings on loading and effort during a handball match. Owing to the complexity of handball the author focuses only on examining energy mechanisms of wing players in their natural setting, i.e. during a handball match. The author establishes the differences between the selected loading and effort variables of a wing playing in the position of the first defence player in 6:0 zone defence and those of another defence player in 3:2:1 zone defence. The introductory chapters therefore describe different types of players' loading during a handball match as well as players' effort, model characteristics of wing players, basic characteristics of zone defence and playing role of wings in 6:0 and 3:2:1 zone defences.

The chapter Method describes the sample of handball players having participated in the empirical part of the research, the used set of variables and tests as well as the data collection procedure. The sample consisted of 12 wing players of the junior-men age category who in the period of measurements were members of senior-men teams and were competing in the first or second Slovene national handball league. The author collected data on players' loading and effort during six model matches. Three matches were played with 6:0 zone defence and three with 3:2:1 zone defence. Four wing players were analysed in each match. Each of the analysed players played one match in each type of defence system. All matches were recorded with three video cameras. The recordings of the two video cameras fastened to the ceiling of the sports hall were subsequently processed by means of computer supported method for individual player tracking (SAGIT System). From the results of the analysed matches the author collected data on the volume and intensity of cyclic movements, frequency of acyclic activities, absolute and relative values of heart rates as well as blood lactate levels.

The author tests the proposed hypotheses by applying appropriate methods of descriptive statistics. The results showed that wing players in 3:2:1 zone defence on average performed a higher volume of cyclic movements than in 6:0 zone defence. Higher average shares in the first and fourth speed classes were achieved by wing players in 6:0 zone defence, while the shares in the second and third speed classes were higher in 3:2:1 zone defence. The author established that among all acyclic activities the variables "stopping" and "approaching" were the ones showing the greatest differences between the wings that played in both defence systems. In his research of variables of effort the author established that the average absolute values of heart rate were higher in 3:2:1 zone defence. The average shares of low and moderate effort were higher in 6:0 zone defence, while the average shares of high and highest effort were recorded in 3:2:1 zone defence. On average, the levels of the measured blood lactates were also higher in 3:2:1 zone defence. Based on these results the author establishes that playing in the position of second defence player in 3:2:1 zone defence is more demanding in terms of both loading and effort, which is most probably the consequence of a more intense activity of wing players in defence. The results showed that in both cases the volume and intensity of cyclic activities diminished in the second part of the match, which was also reflected in the effort variables. The author's findings also have an applicative value, as the established differences between the two real playing models of the wings point to the significance of specific conditioning as well as technical and tactical training of players in view of their playing position in defence and attack as well as the selection of game model.

This doctoral thesis is an original and independent scientific work. With an appropriate disposition and structuring the author succeeded in achieving high transparency of the thesis, which is of particular importance in discussing several topics. A thorough description of the theoretical premises supported by adequate references shows that the author has an extensive knowledge of the discussed issues, both professionally and methodologically, and that he is aware of some of the content and methodological problems that may arise from an empirical study with this kind of disposition. The results and findings presented in this thesis push the boundaries of knowledge in the field of kinesiology, as they offer answers to some questions concerning loading and effort to which a wing player is exposed during a real match with two types of defence systems. The author establishes that research of handball players' loading and effort has to take into account the playing model of the team and the starting playing position of the studied player. The author's findings have an applicative value in addition to the scientific and research ones, as they form a theoretical basis for evolving more optimal strategies for conditioning of handball players. The last chapter of the thesis provides a description of guidelines for further scientific and research work as well as for practical application of the findings in sports practice. It may be concluded that the doctoral thesis of Primož Pori, M.Sc., is a scientific work of outstanding quality and an original contribution to the development of kinesiology in the field of loading and effort in acyclic sports.