

INTERNAL LOAD OF SOCCER GOALKEEPERS DURING A TRAINING PROCESS

<https://doi.org/10.5817/CZ.MUNI.P210-9631-2020-22>

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ABSTRACT

Purpose: The main aim of our research was to determine the internal load of goalkeepers in the soccer training process. The internal load of goalkeepers during the training process is examined according to the achieved values of heart rate. Our goal was to expand the knowledge of the impact of different methodical forms on the goalkeepers' internal load in soccer, thereby support the possibilities of improving their training process. The assumption was that the goalkeepers would achieve significantly different heart rate values in different methodical forms.

Methods: The research group was formed by six elite youth soccer goalkeepers (n=6) from U16, U17 and U19 categories. In order to evaluate the heart rate was used the POLAR PRO heart rate monitor and the loading zones of goalkeepers were determined by using a program called POLAR Team². Subsequently, the obtained data were evaluated by using the Wilcoxon Signed-Rank Test and Cohen's „r“ (effect size).

Results: The average difference in HR_{avg} during preparatory exercise and small-sided game was 25 ± 9 beats.min⁻¹, and the average difference in HR_{max} was 35 ± 12 beats.min⁻¹. During preparatory exercise achieved the goalkeepers' value of HR_{avg} 134 ± 8 beats.min⁻¹ and in small-sided game was HR_{avg} 159 ± 8 beats.min⁻¹. In individual methodical forms were found significantly different average heart rate values ($z = -2.201$, $p < 0.05$, $r = 0.9$), which statistically and logically confirmed our assumption.

Conclusion: Monitoring of soccer goalkeepers' internal load in the process of training and improvement of game activities can greatly help the coaches in further planning, optimization and tracking of the training process. Based on our research's results is recommended to monitor and evaluate the internal load intensity of goalkeepers using sporttesters during entire training process.

Keywords: soccer; goalkeeper; internal load; heart rate

Introduction

The internal load is considered to be some kind of physiological and psychological stress that affects the player's organism (goalkeeper's). It is a certain stimulus for adaptation to training's stimuli with regard to their individual characteristics (Jaspers et al. 2017; Malone et al. 2018). Monitoring of load in training process is the basis for its correct evaluation and subsequent optimization and individualization (Brink et al. 2010; Sannicandro & Cofano 2017; Jaspers et al. 2017; Malone et al. 2018). Players on the field are achieving a higher degree of aerobic persistence than goalkeepers,

which means that they have a different structure of training process (Rebello-Gonçalves et al. 2016; Semjon et al. 2016). This is also confirmed by the research of Gil et al. (2007), who monitored during the particular testing of goalkeepers the highest heart rate values, the lowest VO_{2max} values and thus also the lowest aerobic capacity when comparing to other positions of players. The role of goalkeeper is different from other player's positions and therefore also the requirements for the level of his individual condition abilities are different.

Aim of our research was to evaluate and compare the internal load of goalkeepers in individual methodical forms. The assumption is that goalkeepers will achieve a significantly higher heart rate values in small-sided game than in preparatory exercise

Material and Methods

Subjects

The research group was composed of elite youth soccer goalkeepers (n=6) with an average age of 16.5 ± 0.6 . These goalkeepers are members of soccer academy teams, whose teams play in the highest youth soccer competitions. Goalkeepers in a training microcycle participate during the main period in 5 or 6 trainings.

Table 1 Basic data and training load zones of the observed goalkeepers

GK	GK ₁	GK ₂	GK ₃	GK ₄	GK ₅	GK ₆
Age	17.3	17.1	16.8	16.4	16.0	15.6
Body height [m]	187.0	187.6	191.7	186.8	189.6	175.0
Body weight [kg]	83.0	80.1	84.0	91.4	77.6	63.0
HR _{max} [beats.min ⁻¹]	197	201	198	198	205	200
100–90 %	197–177	201–181	198–178	198–178	205–185	200–180
89–80 %	176–157	180–161	177–158	177–158	184–164	179–160
79–70 %	156–137	160–141	157–138	157–138	163–144	159–140
69–60 %	136–117	140–121	137–118	137–118	143–123	139–120
59–50 %	116–97	120–101	117–98	117–98	122–103	119–100

Methods of measurement

In order to evaluate the heart rate was used the POLAR PRO heart rate monitor and the loading zones of goalkeepers were determined by using a program called POLAR Team². Based on the ascertained maximum heart rates values, POLAR Team PRO calculated the training zones for every goalkeeper. These zones and their division significantly affect the management, individualization, and effectiveness of a training process.

The maximal heart rate of goalkeepers was measured with the test created by Hipp (2007). It is repeating of certain running distances until the runner switches from the basic slow trotting to the running at highest speed and then to the running at individual maximal intensity.

This test consists of:

The field width run

- run at a low intensity (a short run to warm up) – 6 times;
- run at a moderate intensity – 6 times;
- run at a submaximal intensity – 6 times;
- run at a maximal (subjective) intensity – once.

Statistical analysis

The Wilcoxon Signed-Rank Test was used to evaluate the statistical significance. Afterwards we found out the value of Cohen's "r" (effect size). The selected level of statistical significance was $p < 0.05$.

Results

In research, we decided to monitor the organism's functional response to two selected methodical forms.

Table 2. Heart rate values of goalkeepers during a preparatory exercise and individual training load zones

Training Session Report										
PE		HR			Time in sport zones					Above threshold
		Minimum	Average	Maximum	50-59	60-69	70-79	80-89	90-100	
GK 1 Max HR: 197	00:20:00	93	123	143	00:08:43	00:09:27	00:01:50	00:00:00	00:00:00	00:00:00
		47,0%	62,0%	72,0%	43,5%	47,3%	9,2%	0,0%	0,0%	0,0%
GK 2 Max HR: 201	00:20:00	84	137	161	00:07:15	00:03:44	00:07:25	00:01:36	00:00:00	00:00:00
		42,0%	68,0%	80,0%	36,3%	18,6%	37,1%	8,0%	0,0%	0,0%
GK 3 Max HR: 198	00:20:00	101	142	159	00:02:01	00:05:13	00:12:37	00:00:09	00:00:00	00:00:00
		51,0%	71,0%	80,0%	10,1%	26,1%	63,1%	0,7%	0,0%	0,0%
GK 4 Max HR: 198	00:20:00	105	131	157	00:07:50	00:06:49	00:05:17	00:00:04	00:00:00	00:00:00
		53,0%	66,0%	79,0%	39,2%	34,1%	26,4%	0,3%	0,0%	0,0%
GK 5 Max HR: 205	00:20:00	90	124	150	00:12:49	00:05:20	00:01:51	00:00:00	00:00:00	00:00:00
		44,0%	60,0%	73,0%	64,0%	26,7%	9,3%	0,0%	0,0%	0,0%
GK 6 Max HR: 200	00:20:00	128	145	163	00:08:10	00:03:42	00:07:00	00:01:08	00:00:00	00:00:00
		64,0%	72,0%	81,0%	40,8%	18,5%	35,0%	5,7%	0,0%	0,0%

The interval of HR during preparatory exercise was 84 beats.min⁻¹ to 163 beats.min⁻¹. During the preparatory exercise reached the goalkeepers the value of HR_{avg} 134 ± 8 beats.min⁻¹ and the average value of HR_{max} 156 ± 7 beats.min⁻¹.

Table 3. Heart rate values of goalkeepers in a small-sided game and individual training load zones

Training Session Report										
SSG	🕒	HR			Time in sport zones					Above threshold
		Minimum	Average	Maximum	50-59	60-69	70-79	80-89	90-100	
GK 1 Max HR: 197	00:20:00	112	147	186	00:01:32	00:06:01	00:04:15	00:06:19	00:01:53	00:02:59
		56,0%	74,0%	94,0%	7,6%	30,0%	21,3%	31,6%	9,5%	14,9%
GK 2 Max HR: 201	00:20:00	106	167	201	00:00:25	00:03:03	00:04:03	00:02:54	00:09:35	00:09:54
		53,0%	83,0%	100,0%	1,8%	15,3%	20,3%	14,6%	48,0%	49,6%
GK 3 Max HR: 198	00:20:00	110	151	179	00:01:36	00:05:32	00:02:59	00:09:31	00:00:22	00:01:25
		55,0%	76,0%	90,0%	8,1%	27,6%	14,9%	47,5%	1,9%	7,1%
GK 4 Max HR: 198	00:20:00	102	156	182	00:01:36	00:03:49	00:03:27	00:08:03	00:03:05	00:05:17
		51,0%	78,0%	91,0%	8,1%	19,1%	17,2%	40,2%	15,4%	26,4%
GK 5 Max HR: 205	00:20:00	100	164	203	00:01:37	00:04:05	00:02:57	00:02:22	00:08:59	00:09:36
		49,0%	80,0%	99,0%	7,8%	20,5%	14,8%	11,9%	45,0%	48,1%
GK 6 Max HR: 200	00:20:00	129	166	190	00:00:00	00:01:32	00:06:09	00:05:18	00:07:01	00:07:57
		64,0%	83,0%	95,0%	0,0%	7,4%	30,9%	26,5%	35,2%	39,8%

The interval of HR during small-sided game was 100 beats.min⁻¹ to 203 beats.min⁻¹. During the small-sided game reached the goalkeepers the value of HR_{avg} 159 ± 8 beats.min⁻¹ and the average value of HR_{max} 190 ± 9 beats.min⁻¹.

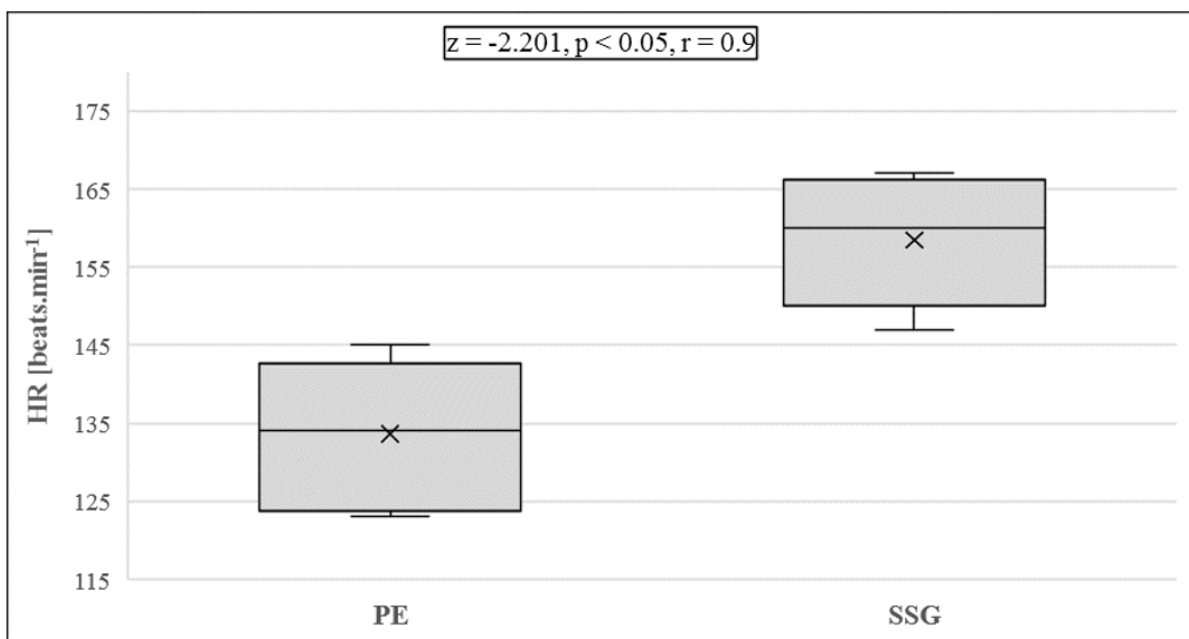


Figure 1 Comparison of goalkeeper's internal load in individual methodical forms

The average difference in HR_{avg} during preparatory exercise and small-sided game was 25 ± 9 beats.min⁻¹ and average difference in HR_{max} was 35 ± 12 beats.min⁻¹. During the preparatory exercise reached the goalkeepers the value of HR_{avg} 134 ± 8 beats.min⁻¹ and in small-sided game was HR_{avg} 159 ± 8 beats.min⁻¹. There were some significantly different average heart rate values found in individual methodical forms ($z = -2.201, p < 0.05, r = 0.9$), which statistically and logically confirmed our assumption.

Discussion

Babic, Holienka & Mikulič (2018) found out in their research, that goalkeepers during the small-sided games reached $HR_{avg} 159 \pm 5 \text{ beats.min}^{-1}$, or more precisely $149 \pm 4 \text{ beats.min}^{-1}$. Babic & Holienka (2018) also found similar results and significant differences ($p < 0.05$). Goalkeepers reached $HR_{avg} 130 \pm 5 \text{ beats.min}^{-1}$ during preparatory exercise and $HR_{avg} 156 \pm 9 \text{ beats.min}^{-1}$ during small-sided game. We can only agree with Peráček & Hrnčiarik (2012), that when are creating the conditions for a regular individual training at this stage of the youth sports preparatory in soccer, it is necessary to devoted to the development of physical abilities and game skills. Goalkeepers in the youth categories should improve their technical aspects of defensive and offensive play activities; they should focus on improving conditions under time and space pressure (match conditions) and under fatigue.

Conclusion

Monitoring of soccer goalkeepers' internal load in the process of training and improvement of game activities can greatly help the coaches in further planning, optimization and tracking of the training process. According to the results of our research, it is recommended to monitor and evaluate the goalkeeper's internal load intensity by sporttesters during entire training process.

Acknowledgements

This study was supported by the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences (No. 1/0824/17): Specific methods and innovative procedures for assessing performance in athletes and physical fitness in the general population.

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