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Management of Efficiency of Medical Support of Amateur Sports on The Example of Mini-Football

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Abstract

The article examines the factors that influence the medical support of amateur sports (on the example of mini-football). For the purposes of the study, the results of the questioning of amateur athletes on the factors and their influence on the level of medical support for amateur sports are used. The study is carried out using econometric methods - the method of least squares, tests on the significance of the model parameters and the model as a whole, heteroscedasticity, multicollinearity. According to the results of the study, the authors of the article made an important conclusion about the fundamental factors that should be paid attention when organizing amateur sports events for the development of medical support for amateur sports.

Keywords: Medical support; Amateur sport; Traumatism; Sport.

1. Introduction

The popularity of amateur sports is growing, especially this trend can be traced to the example of mini-football. Classes in amateur sports are associated with injuries, fatigue, overstrain of the body during the training process, and there are also a number of restrictions for people with chronic diseases. Avoiding injuries, preventing diseases and maintaining the health of athletes is the primary goal of medical support for amateur sports. The task was to ensure the sustainable development of the Institute of Medical Support in the field of amateur sports, on the example of a mini-football popular among Kazan residents. Doctors and health professionals often participate in various counseling and assistance opportunities in various sports clubs and sporting events. There are different levels of support that a doctor can provide, depending on the size and type of club or event (Pyatkina, 2016). They can range from a sports medicine doctor who provides a regular, highly professional level of service in a professional sports club, to a doctor who provides unpaid care at a local community event on a one-time basis. Medical care at sporting events, be it amateur sports or sports of higher achievements, is important for the smooth operation of these activities and for ensuring the safety and well-being of participants, officials and spectators. Management and organization of medical care guarantees the safety of all participants in sports events (Katruta and Strizhov, 2015).

2. Methodology

The material for the work was the survey data, the questionnaire was developed by the authors of the study (Leto et al., 2015).

In order to describe and predict the indicator model - the level of medical support for amateur sports and the impact of various indicators on it - it is advisable to use econometric methods of modeling. As the data for econometric modeling, the results of the survey will be used - estimates of fifty respondents whose professional field of activity is participation in mini-football competitions. Expert assessments are obtained through questionnaires on indicators that affect the level of medical support for amateur sports, as well as assess its current level. Data on indicators, as well as on the level of medical support for amateur sports, range from 0 to 1. When processing the results of the questionnaire and for quantifying the results, the verbal-numerical Harrington scale was used (Table 1) (Aubakirova *et al.*, 2018; Gabdrakhmanov and Egorov, 2016; Razumovskaya *et al.*, 2014).

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Table-1. Harrington scale for research purposes

A qualitative description of the impact of indicators on the level of medical support for amateur sports	Accepted numerical value	The average value in the questionnaire
Very Low	0,0-0,2	0,1
low	0,2-0,37	0,28
Average	0,37-0,64	0,5
High	0,64-0,8	0,72
Very high	0,8-1,0	0,9

Econometric modeling of the level of medical support for amateur sports, which includes the identification of model indicators using the method of least squares, the subsequent evaluation of the obtained model quality indicators, graphical analysis, it is expedient to carry out using the application product Gretl. For the purposes of econometric modeling, we introduce the following notation (Aubakirova et al., 2018):

- Y – the level of medical support for amateur sports;
- X_1 – the frequency of insurance compensation for treatment for injury in amateur sports;
- X_2 – frequency and quality of medical examinations in amateur sports;
- X_3 – expectations about improving the level of medical support for amateur sports in the future;
- X_4 – the frequency of injuries in amateur sports for the season;
- X_5 – - the quality of first aid in case of injuries in amateur competitions.

When assessing the factors of the model and their impact on the dependent factor - the level of medical support for amateur sports, - it is advisable to use the least squares method, the purpose of which is to minimize the sum of the quadratic deviations between observed and calculated values. The formula for the method of least squares:

$$b = \frac{\sum_{i=1}^{n} Y}{n} - \frac{a * \sum_{i=1}^{n} X}{n} \quad (1)$$

Where:

Y – the predicted value;

a и b - coefficients;

X - conventional designation of the independent factor.

The resulting model, explaining the level of medical support for amateur sports, is shown in Figure 1, which shows the main indicators of the quality of the model obtained (Kuleshov, 2016).

Figure-1. Econometric model of the level of medical support for amateur sports according to the results of the survey and the impact on it of indicators

Model
used observations 1-50 Dependent variable:Y

	coefficient	statistical error	t-statistics	P-value	
const	−0,328509	0,101392	−3,240	0,0023	***
X1	0,250810	0,103905	2,414	0,0200	**
X2	0,355083	0,0943168	3,765	0,0005	***
X3	0,131366	0,0937111	1,402	0,1680	
X4	0,467746	0,0993528	4,708	2,51e−05	***
X5	0,479824	0,100840	4,758	2,13e−05	***

mean dependent variable	0,595600	Dependency st. of dep. ch.	0,217567
sum of squares of residues	0,713292	st. error of the model	0,127323
R- square	0,692471	Corrected R-square	0,657525
F(5, 44)	19,81522	P-value (F)	2,71e−10
Log. credibility	35,30026	Akaike criterion	−58,60053
Schwartz criterion	−47,12839	Hennan-Quinn criterion	−54,23187

Excluding the constant the greatest p-value obtained for variable 4 (X3)

3. Results

It is reasonable to analyze the reliability of the obtained coefficients by means of an analysis of the obtained P-values. P-value is the value used in testing statistical hypotheses. If the P-value is less than 0.05, then the coefficient is significant at the level of 0.05. If the P-value is less than 0.01, then the coefficient is significant at the level of 0.01 (Galustyan, 2015).

The P values obtained from the model were:

- p_{const} = 0, 0023;
- p_{x1} = 0, 0200

- p_{x2} = 0, 0005;
- p_{x3} = 0,1680;
- p_{x4} = 2,51e-05;
- p_{x5} = 2,13e-05.

Accordingly, the factors const, X_2, X_4, X_5, which are significant at the level of 0.01, and the factor X_1, , which is significant at the level of 0.05.

It is also necessary to verify the significance of the model with respect to the determination coefficient to verify the significance of the model as a whole.

The coefficient of determination (R^2) — is the fraction of the variance of the dependent variable, explained by the model under consideration. In the case of using a sample estimate of the values of the corresponding variances, a formula for the selective determination coefficient is obtained:

$$R^2 = 1 - \frac{\hat{\sigma}^2}{\hat{\sigma}_y^2} = 1 - \frac{SS_{res}}{SStot} \quad (2)$$

где $SS_{res} = \sum_{i=1}^{n} e_i^2 = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$ - The amount of the squares of the regression residuals;

$y_i, \hat{y}_i$ - actual and calculated values of the explained variable;

$SS_{tot} = \sum_{i=1}^{n} (y_i - \bar{y})^2 = n\hat{\sigma}_y^2$ - is the total amount of the squares;

$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$.

In the model obtained, R^2 was 0.6924.

Interpretation of this indicator means that the model is reliable, it is significant by 69.24%, that is 69.24% of changes in the indicator of the medical support level of medical sports according to the results of the questionnaire is explained by the constructed model, and 30.76% of the change in the indicator is due to the action of random, not included in the model of factors. In other words, the accuracy of the selection of the regression equation using the least squares method is adequate, further analysis of the model is required to find and eliminate errors, if they exist, checking the model for heteroscedasticity and multicollinearity of the residues (Markovich, 2015). The assumption of the constancy of variance of residues is known as the assumption of homoscedasticity. If this assumption is violated and the variance of the residues is not constant, then the estimates are heteroscedastic. To confirm the presence or absence of heteroscedasticity, it is advisable to use the White test using the Gretl application package, and the results of this test are shown in Figure 2.

Figure-2. White's test for the constructed model of the level of medical support for amateur sports according to the results of the survey and the impact on it of the indicators

White's test (white) test for heteroscedasticity
MNK used observations 1-50
Dependent variable : uhat^2
missed due to perfect collinearity : X5_X6
X4_X6 X3_X6 X5_X6 X4_X6 X5_X6

	coefficient	statistical error	t-statistics	p-value
const	0,0286410	0,0790510	0,3623	0,7193
X1	0,0300313	0,119452	0,2514	0,8030
X2	−0,0537936	0,0952559	−0,5647	0,5759
X3	0,00587221	0,101319	0,05796	0,9541
X4	−0,0267329	0,103051	−0,2594	0,7968
X5	−0,00154150	0,138590	−0,01112	0,9912
sq_X1	−0,0387975	0,0817362	−0,4747	0,6380
X5_X6	−0,0529579	0,106525	−0,4971	0,6222
X4_X6	−0,0397897	0,0969802	−0,4103	0,6841
X3_X6	0,0794851	0,119144	0,6671	0,5091
X2_X6	0,0402712	0,117840	0,3417	0,7346
sq_X2	−0,0172227	0,0650730	−0,2647	0,7928
sq_X3	0,0382683	0,0783308	0,4885	0,6282
sq_X4	0,0638485	0,0855965	0,7459	0,4607
sq_X5	−0,0364574	0,0978367	−0,3726	0,7117

uncorrected R-square = 0,192540

test statistics : TR^2 = 9,626988,
P-value = P(Хи-square (14) > 9,626988) = 0,788915

For a final conclusion about the presence or absence of heteroscedasticity of the residues, it is necessary to find $F_{crit.}$, which turned out to be 30.5779 (Fig. 3).

Figure-3. Critical value for the White test

Хи- square (15)
right-sided probability = 0,01
complementary probability = 0,99

critical value = 30,5779

As a result, the White test showed that the P-value is 0.7889 (which is greater than P = 0.01 and P = 0.05), with $F_{calc.}$ (9, 626988) < $F_{crit.}$ (30, 5779). Thus, the hypothesis H_0 on the presence of homoscedasticity of the residues is accepted and the alternative hypothesis H_1 on the presence of heteroscedasticity of the residues is accepted, that is, the variance of the residues is constant. The final stage of the verification of the constructed econometric model for reliability is the verification of the model for the multicollinearity of the dependent variables. By multicollinearity, it is common to understand the high correlation between the explanatory variables x (Aubakirova *et al.*, 2018; Kondrateva and Plotnikova, 2018).

4. Discussion

There are no exact quantitative criteria for determining the presence or absence of multicollinearity. Nevertheless, some heuristic approaches are used to identify it, for example, the method of inflation factors. If the minimum value of the inflation factor is greater than 5 (10), then a conclusion is made about the possible presence of multicollinearity.

The results of the method of inflation factors are shown in Figure 4. White test.

Figure-4. Results of application of the method of inflation factors with the purpose of revealing multicollinearity

method of inflationary factors
the minimum possible value = 1.0
values : > 10.0 may indicate multicolinearity

X1	1,258
X2	1,237
X3	1,136
X4	1,201
X5	1,053

VIF(j) = 1/(1 - R(j)^2), R(j) - coefficient of multiple correlations between variable j and other independent variables

As a result, econometric methods have established that there is no multicollinearity between independent factors. Thus, the obtained model of the level of medical support for amateur sports (Y) and the impact on it of the indicators is as follows:

$$Y = -0{,}3285 + 0{,}2508 * X_1 + 0{,}3551 * X_2 + 0{,}4678 * X_4 + 0{,}4798 * X_5.$$

Where:
- X_1 – frequency of insurance compensation for treatment in case of injury in amateur sports;
- X_2 – frequency and quality of medical examinations in amateur sports;
- X_4 – the frequency of injuries in amateur sports for the season;
- X_5 – the quality of first aid in case of injuries in amateur competitions.

5. Summary

Thus, according to the results of the study, the expectation factor about the improvement in the level of medical support for amateur sports in the future turned out to be insignificant in general for the level of medical support for amateur sports, since in reality these are only the expectations of amateur athletes, a factor that can have a significant impact on the level of medical care. The least impact on the development of medical support for amateur sports is the factor of the frequency of insurance compensation for injuries in amateur sports, since this factor is a consequence of the development of medical support for amateur sports, and not its cause. Therefore, it is necessary to analyze the influence of more in-depth factors, which are the primary reasons for the development of medical

support for amateur sports. First of all, this factor is the frequency of injuries in amateur sports for the season, as the increase in the frequency of injuries, in essence, should affect the quality of medical care for athletes. Thus, an increase in the frequency of injuries per season by 1% leads to an increase in the level of medical support for amateur sports by 0.4678%. However, this factor is not the most significant. Undoubted fact is the influence of the quality and frequency of medical examinations on the level of development of medical support for amateur sports, after all, according to the results of the research, with the increase in the quality and frequency of medical examinations of amateur athletes by 1%, the level of medical support is increased by 0.3551%. The most significant factor for the level of medical support for amateur sports was the quality factor of providing first aid in case of injuries in amateur competitions, and not by chance. After all, the presence of a medical base at the events themselves significantly determines the quality and speed of medical assistance to amateur athletes. Consequently, the level of development of medical support for amateur sports is also growing.

6. Conclusions

As a result of the conducted research it can be concluded that in the future organizers of amateur sports events need to pay attention to the development of the most significant factors that can affect the level of medical support. At the same time, it should be noted that the growing quality of medical support for amateur sports should lead to a reduction in injuries and its consequences at competitions, and not vice versa.

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