

## **The universal combined event for throwers**

Assoc. prof. dr. Kęstutis Vislavičius  
Vilnius Gediminas Technical University

### **Summary**

*We have to admit that there is not a combined event for throwers, which would satisfy each and every sports veteran. Perhaps its existence is even impossible. Therefore, the organizers of sports veterans' competition often include only single throwing events into competition program. Usually there are some events from classical throwing events list: shot put, discus throw, javelin throw or hammer throw, as well as from non-classical events list: stone put, antique discus throw, slingball throw, grenade throw and others.*

*More often the competition organizers are trying to determine the strongest competition thrower estimating the results of each competitor achieved in single events. It is not easy, because sports veterans compete in putting or throwing implements of various weights depending on the age group. Also, each event is containing different amount of results, which can be used in the statistical analysis.*

*The article presents the technique and algorithm, which allow to determine the strongest competition thrower. The age of competitors, the weight of implements and particularity of events are evaluated. The technique and algorithm presented are illustrated using results of one competition and the data obtained are analysed. Conclusions and suggestions are presented.*

**Keywords:** Veterans sports, combined event, age coefficient, event coefficient, level of competition.

### **Introduction**

Sports veterans' movement in all over the World especially affected the athletics sport. There were added a lot of events, which are appointed only for veterans. Especially the throwers expanded number of events. Now, the most popular events are various combined events.

We have to admit that there is not a combined event, which would satisfy each and every sports veteran. Perhaps its existence is even impossible. Let's look at throwers pentathlon – there are two hammer throw events, therefore, the hammer throwers are favoured, like in shockorama discus throwers are in front of others. The Edwin Kollmar's decathlon seems to be too cumbersome.

However, it is obvious, that Edwin Kollmar's decathlon is the most universal combined event, because, firstly, it unites classical and non-classical throwing events, secondly, the setting of the events gives everybody equal opportunities to win – from shot putters to discus, javelin or hammer throwers. Finally, in order to win this competition a veteran has to be strong, fast, coordinated and tough. It can even be said, that the winner of Edwin Kollmar's decathlon can be fairly called the king of the competition. But this decathlon itself is still really overloaded. To arrange competition properly 30 sports implements (14 out of them are non-classical), 6 sectors and special tables for results calculations are needed. In addition, competition is very long and tiring. There are the main reasons why the competition programs often consist of single events only.

Nowadays, the sports veterans compete not only in the classical throwing events but in non-classical events too. The most popular non-classical events are: stone put, antique discus throw, slingball throw, one hand hammer throw, grenade throw, historical hammer throw and Scottish (Igmand) hammer throw. Despite the fact that veterans are competing in different single events, organizers of competition want to clarify the strongest competition thrower. Unfortunately, there is an appropriate methodology to enable it to do.

The research presented is based on the mathematical statistical methods (Aivazian, Mkhitarian, 2001; Kendall, 1970; Montgomery, 1977; Saaty, 1980), which are successfully used when comparing various indicators of phenomena and objects. For example, they have been adapted to the determination of the best veteran-thrower of any event, taking into account different age of competitors and different weight of implements (Vislavičius, Pocius, Pečiūra 2003).

The aim of research is to present the technique and algorithm, which allow to determine the strongest competition thrower. The age of competitors, the weight of implements and particularity of events must be evaluated.

### **The algorithm of calculating event coefficients**

#### *Age group basic standard of the event results*

The veteran-throwers compete in five years age groups: 30-34, 35-39, 40-44, etc. Let us introduce the concept of age group basic standard of the event results. This value describes results of particular age group of an analysed event. It should not be world record, because the one strong athlete can „distort“ relations between basic standards of different age groups, as well as events. While usually the age group rating list has over twenty records, it is proposed to calculate the average result of the best ten athletes' results. When there is less data (for example, 75-79 age group), then it is proposed to calculate the average result of a half of the best athletes' results.

In addition, statistically least reliable are the results of the youngest and the oldest athletes. Therefore, when calculating the event coefficient it is proposed to evaluate only the nine age groups (from 35 to 79 years) results.

The results of calculation of all age groups basic standards of hammer throw event are presented in Table 1. Initial data are taken from (*website: <http://www.mastersathletics.net>*).

Table 1

**The results of calculation of all age groups basic standards of hammer throw event**

Age group	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Number of results	65	55	50	46	44	50	46	45	31	23	20	7
Results	83,62	82,23	70,36	71,71	63,70	63,32	55,74	59,04	51,51	43,23	32,52	24,61
	82,80	80,03	67,74	66,92	62,37	62,72	55,70	55,36	47,67	43,11	32,20	24,51
	82,62	78,36	64,70	65,30	60,88	61,76	54,79	53,12	45,92	41,38	29,99	23,91
	82,52	75,76	63,46	63,66	60,26	61,70	54,08	52,95	44,93	40,07	29,55	23,87
	82,45	75,66	63,45	63,56	60,10	61,54	54,06	52,70	44,70	39,72	29,36	
	82,16	75,62	62,86	63,22	59,74	61,19	53,82	52,63	44,51	38,98	28,72	
	81,86	74,49	62,52	62,73	59,52	59,97	53,80	52,42	44,36	38,78	28,36	
	81,75	74,34	62,13	62,51	59,43	59,72	53,67	52,02	44,31	37,85	28,01	
	81,66	73,63	61,20	62,16	58,78	58,39	53,60	51,65	43,84	37,41	27,90	
81,27	72,40	60,80	62,00	58,54	58,10	53,32	50,78	43,62	37,18	27,51		
Basic standard	82,27	76,25	63,92	64,38	60,33	60,84	54,26	53,27	45,54	39,77	29,41	24,23

#### Age group standard of the event results

The age group basic standard of the event results is an objective index. It depends only on the results quantity. However, for comparing athletes' results of different age groups, the age coefficients are necessary.

When basic standards  $B_{i,j}$  and age coefficients  $C_{i,j}$  of the  $i$ -th event of the  $j$ -th age group are known, the standards  $\bar{S}_{i,j}$  of the  $i$ -th event of the  $j$ -th age group are equal to:

$$\bar{S}_{i,j} = B_{i,j} \cdot C_{i,j}, \quad i = 1, 2, \dots, n, \quad j = 1, 2, \dots, m, \quad (1)$$

where  $n$  is the number of events;  $m$  is the number of age groups.

When the yearly age coefficients are used instead of age groups coefficients, the middle age of particular age group is used, for example 37, 42, etc.

In practice, the application of age coefficients is dual. Some researchers use age groups coefficients, while others - yearly age coefficients. Moreover, there is no information about the age coefficients setting methodology, which is not given even by the World Masters Association (WMA).

If age coefficients are good, the all age groups standards of the event results (which are calculated when the basic standard is multiplied by the age coefficient) have to be approximately equal to each other. Analysis of results shows that even the WMA's age coefficients are not accurate. The age groups standards of the hammer throw event results, which are calculated using the WMA's age coefficients, are presented in Table 2. The analysis of results shows, that some age groups standards are higher than the World record (86,74 m). These standards are written in bold. The age group standards of the Scottish hammer throw event results are presented in Table 3. Initial data are taken from (LSW Spezijsport: Bestleistungen, Statistik und Meisterschaften, 1990-2011; LSW Senioren-Leichtathletik-Zeitung, 1990-2003; website: <http://www.lsw-spezijsport.de>; website: <http://www.pkwla.eurekaweb.pl>), the yearly age coefficients are calculated using the methodology from the article (Vislavičius, Pocius, Pečiūra, 2003). The analysis of results shows, that in this case the age coefficients are more precise than the age coefficients of WMA. In Table 3 there is only one standard written in bold.

Table 2.

**Hammer throw event statistics**

Age group	Basic standard	Yearly age coefficient	Standard
35-39	82,27	1,0304	84,77
40-44	76,25	1,1194	85,35
45-49	63,92	1,2324	78,78
50-54	64,38	1,2156	78,26
55-59	60,33	1,3616	82,15
60-64	60,84	1,4725	<b>89,59</b>
65-69	54,26	1,6706	<b>90,65</b>
70-74	53,27	1,7072	<b>90,94</b>
75-79	45,54	2,0063	<b>91,37</b>
Event standard			85,76
Event statistical coefficient			1,17

Table 3

Scottish hammer throw event statistics			
Age group	Basic standard	Yearly age coefficient	Standard
35-39	20,06	1,052	21,10
40-44	18,03	1,102	19,87
45-49	19,66	1,165	22,90
50-54	25,59	0,846	21,65
55-59	23,04	0,912	21,01
60-64	22,74	0,994	22,60
65-69	19,31	1,095	21,14
70-74	27,60	0,911	<b>25,14</b>
75-79	21,20	1,027	21,77
Event standard			21,91
Event statistical coefficient			4,56

#### Standard of the event results

When the standards  $\bar{S}_{i,j}$  of the  $i$ -th event of the  $j$ -th age group are known, the standards  $\bar{S}_i$  of the  $i$ -th event are calculated using the following formula:

$$S_i = \frac{\sum_{j=1}^m \bar{S}_{i,j}}{m}, \quad i = 1, 2, \dots, n. \quad (2)$$

The standards of classical and Scottish hammers throw events are written in one row from the bottom of Tables 2 and 3. The standards of throwing events investigated are presented in Table 4.

#### Statistical coefficient of the event

Having separate events standards, the achieved result level can be assessed in two ways. In the first case the part of athletics' achieved results in comparison with the standard is calculated. In the second case the percentage of the achieved result by the standard event is determined. The first method is not picturesque; therefore the second method is discussed in the article.

It is assumed that the accredited standard of all events is the same and equals 100 m. Then the event statistical coefficient of  $i$ -th event is:

$$\alpha_i = \frac{100}{S_i}, \quad i = 1, 2, \dots, n. \quad (3)$$

The statistical coefficients of classical and Scottish hammers throw events are presented in the last rows of Tables 2 and 3. The statistical coefficients of throwing events investigated are presented in Table 4

The achieved result multiplied by the event statistical coefficient is named by the comparative result. The comparative result shows the level of the achieved result. If, for example, it is equal to 80.00 m, this means that it represents 80% of the event standard independently if it is a shot put, discus throw or other event.

#### Coefficient of event

The computational experiment (the athletes' results achieved in the same competition were investigated) has showed, that comparative results of different events are significantly different. It became obvious, that the coefficient of event popularity or coefficient of sample size is necessary. The analysis of results showed, that the smallest comparative results are in classic events (shot put, discus, javelin and hammer throws), slightly higher – in weight throw event, and even more higher comparative results are in non-classical throwing events. The largest comparative results are in the Scottish hammer throw event, which is the “younger” non-classical event. Such increase of comparative results can be easily explained. Competitions of classic throwing events for veterans have already been carried out for more than 36 years. In 1975 in Toronto (Canada) the first veteran athletics World championship was held, which was attended by 1427 athletes from 32 countries. The weight throw event was added much later in the program of the World, European veteran athletics championships or World Master Games. In 1990 the first World veteran championship of the non-classical throwing events was held and the Scottish hammer throw event was included in the World veteran championship program only a decade ago. Because the comparative results of classical events are almost equal, it was

recommended to set the one event popularity coefficient, which equals to one. The event popularity coefficients of all investigated throwing events are presented in Table 4.

Finally, let's denote the event popularity coefficient of the  $i$ -th event by  $\beta_j$  and the achieved result by  $R_j$ . Then the coefficient of the  $i$ -th event

$$\lambda_i = \beta_i \cdot \alpha_i, \quad i = 1, 2, \dots, n. \quad (4)$$

Finally, the comparative result (or index of result level) of the  $i$ -th event

$$L_i = \lambda_i \cdot R_i, \quad i = 1, 2, \dots, n. \quad (5)$$

The coefficients of investigated events are presented in Table 4.

Table 4

No.	Event	Standard of event (m)	Statistical coefficient of event	Coefficient of event popularity	Coefficient of event
1.	Shot put	22,58	4,43	1	4,43
2.	Discus throw	69,23	1,44	1	1,44
3.	Javelin throw	89,58	1,12	1	1,12
4.	Hammer throw	85,76	1,17	1	1,17
5.	Weight throw	23,53	4,25	0,92	3,91
6.	Stone put	11,20	8,93	0,82	7,32
7.	Antique discus throw	27,31	3,66	0,85	3,11
8.	Sling ball throw	70,29	1,42	0,82	1,16
9.	One hand hammer throw	30,85	3,24	0,80	2,59
10.	Grenade throw	73,17	1,37	0,82	1,12
11.	Historical hammer throw	12,70	7,87	0,84	6,61
12.	Scottish hammer throw	21,91	4,56	0,75	3,42

## Numerical experiment

The technique presented was used in "Five hammers-2011" competition, which was held in Alytus. In the competition sport veterans of various capacity and sports specialization took place. The results are presented in Table 5.

The analysis of results, which was obtained using technique presented, gives a lot of interesting information. First of all, every athlete can see the best and worst results achieved in any event. For example, the best start of R. Medišauskas is in historic hammer throw event (75,20 m), worst - in one hand hammer throw event (62,78 m). Also, each athlete can see the comparative result in combined event. For example, the comparative result of R. Medišauskas (69,96 m) shows, that it makes up 69.96% of the event standard. The result in bold (Table 5) characterizes the level of the competition (in Alytus it was 56,41 m). According to this indicator the competitions can be divided by ratings.

**Note.** In the last line of Table 5 there are presented comparative results of the separate events, which are minimally different. According to these results it can be said that the all athletes were equally strong in separate events and that event popularity coefficients are determined sufficiently exactly when there was little statistical data.

Table 5

No.	Sportsman	Age	Hammer		Weight		One hand hammer		Historical hammer		Scottish hammer		Combined event	
			*	**	*	**	*	**	*	**	*	**	Result	Index of result level
1.	Medišauskas R.	49	48,16	72,24	14,33	69,79	21,10	63,72	9,28	75,17	16,81	68,75	349,67	69,93
3.	Pridotkas G.	53	42,80	62,06	16,08	73,49	18,77	59,88	8,17	71,00	25,25	73,98	340,41	68,08
4.	Kulbokas L.	49	40,87	61,31	14,07	68,52	22,55	68,10	8,35	67,64	17,93	73,33	338,90	67,78
2.	Baltrušaitis J.	52	46,32	65,77	14,67	65,87	15,40	48,36	6,44	54,93	20,46	59,13	294,06	58,81
5.	Jančiauskas R.	42	43,16	56,54	10,33	45,45	21,25	59,50	7,32	53,73	14,17	53,42	268,64	53,73
6.	Baranauskas D.	25	37,68	44,09	11,21	43,83	19,85	51,41	6,17	40,78	13,9	47,54	227,65	45,53
7.	Kunc R.	40	33,03	41,62	9,71	41,56	17,06	47,09	6,09	43,48	13,28	49,14	222,89	44,58
8.	Snieckus D.	38	31,62	38,58	9,66	40,28	16,25	44,20	6,22	43,73	13,61	49,40	216,19	43,24
Comparative results				55,28		56,10		55,28		56,31		59,34		<b>56,46</b>

\* - achieved result

\*\* - comparative result (achieved result multiplied by coefficient of event)

Note: The index of competition level is 56,46 m

## Conclusions

1. In the article it has been shown, that WMA's age coefficients are not accurate. They are not objectively higher for older sports veterans.

2. When comparing the comparative results of classical and non-classical throwing events, it has been noticed, that because of very different quantities of results it is necessary to determine the event popularity coefficients.

3. Numerical experiments have shown that technique presented is simple, it does not complicate the competition secretariat work (the result must be multiplied by event coefficient only) and adds variety to veterans competition, allowing to determine the comparative result of a winner as well as the index of competition level.

4. There is a possible to adjust the yearly age coefficients of separate events, when determining the age groups standards of the events results.

5. The article presents the event coefficients only for men. Using the same methodology, event coefficients for women have to be determined too.

6. The age groups basic standards of the events results are objective (it depends only of sample size). Less objective are the age groups standards of the events results, because the age coefficients are used in their establishment. They are obtained by different methods. The least objective are event popularity coefficients, because there is not much data, when the same athletes competed in separate classical and not-classical events in the same competition. Therefore, it is proposed to recalculate the event coefficients in about every ten, fifteen years.

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## UNIVERSALIOJI METIKŲ DAUGIAKOVĖ

**Doc. dr. Kęstutis Vislavičius**  
*Vilniaus Gedimino technikos universitetas*

### SANTRAUKA

Pasaulyje besiplečiantis sporto veteranų sąjūdis neaplenkė ir lengvosios atletikos. Ją papildė daug rungčių, pritaikytų tik sporto veteranams. Naujų rungčių gausa išsiskiria metikų varžybos. Populiariausios rungtys – įvairios daugiakovės. Vienas iš jų sudaro tik klasikinės lengvosios atletikos rungtys, kitas – klasikinės ir originalios rungtys, kai kurios iš jų pripažintos pasauliniu mastu (pavyzdžiui, metikų penkiakovė, kuri įtraukta į pasaulio ir Europos lengvosios atletikos pirmenybių programą), o kitos populiarios tik tam tikrose šalyse (pavyzdžiui, Vokietijoje populiari rutulio stūmimo penkiakovė, Vengrijoje - trumpojo kūjo metimo trikovė, Lietuvoje - svarsčio metimo penkiakovė).

Reikia pripažinti, kad dar nėra daugiakovės, kuri tenkintų visų veteranų norus (matyt, tokios daugiakovės ir negali būti). Todėl, į metikų veteranų varžybų programą dažnai be klasikinių metimo rungčių (rutulio stūmimo, disko, ieties, kūjo ar trumpojo kūjo metimo) įtraukiamos ir neklasikinės metimų rungtys: akmens stūmimas, Antikos disko metimas, kamuolio su kilpa metimas, granatos metimas ir kitos. Dažnai varžybų organizatoriai nori išaiškinti geriausią tarp geriausių varžybų dalyvį, įvertindami veteranų pasiektus rezultatus atskirų rungčių varžybose. Tai nėra paprasta, nes veteranai varžosi atskirose amžiaus grupėse stumdydami ar mėtydami įvairios masės sportinius įrankius. Be to, rungtys labai įvairios, turinčios skirtingus kiekius rezultatų, reikalingų statistinei analizei.

Straipsnyje pateikiama metodika, skirta nustatyti geriausią tarp geriausių varžybų dalyvį, nepriklausomai nuo to, kokios rungtys buvo įrašytos į varžybų programą. Ji įvertina ir sportininko amžių, ir rungties specifiką, ir rungties rezultatų skaičių. Trylikai populiariausių rungčių nustatyti rungčių koeficientai. Pateiktas rungčių koeficientų taikymo pavyzdys. Atlikta rezultatų analizė.  
*Raktažodžiai:* veteranų sportas, daugiakovės, amžiaus koeficientas, rungties koeficientas, varžybų lygio rodiklis.

Kęstutis Vislavičius  
S. Stanevičiaus g. 11-1, LT-07134, Vilnius  
Tel. +370 699 67349  
El. paštas: [vislavicius@vgtu.lt](mailto:vislavicius@vgtu.lt)