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## ASSESSMENT OF EXERCISE INTENSITY DURING AMATEUR RUNNING COMPETITIONS IN THE SUDETY MOUNTAINS

**Abstract:** The aim of the study is to determine the intensity of exercise during amateur running competitions taking place in the Sudeten Mountains, based on results of measurements of energy expenditure. The study covered those participating in 2015-17 and included details on themselves and their preparation. Their energy consumption was measured using a CALTRAC™ device. Routes are described by distance (km) and altitude (m). Average energy output values for 19.2 km and 613.8 m were calculated from measurements taken which was characterized as 'unduly heavy'. In women this value was 11.6 kcal/1 min/55 kg and in men - 12.7 kcal/1 min/65 kg.

**Keywords:** physical recreation, physical activity, health promotion.

### 1. THEORETICAL CONTEXT

Tourism and recreation have a mission to promote health by stimulating all kinds of physical activity. Thus not only recreation, but also the improvement of health and prevention of disease, especially diseases of 'civilization' (ZAMEŁYŃSKA 2005). Recreation as physical activity takes place in free time after occupational, educational and domestic duties (KOSIEWICZ 2006). The type of exercise depends on the interests and 'creativity' of the individual. By meeting the need for exercise, emotional stress can be reduced or eliminated; a great way to relax after the daily routine. Well-being and willingness to work are improved. When choosing physical activities, attention should be paid to an individual's age, sex and physical capacity. Regular physical activity helps prevent disease and poor health (NOWAK 2011). The cardiovascular system is reinforced (POSŁUSZNY 2011), blood pressure and blood supply to the body are improved, while regular physical exercise prevents obesity, and positively affects the body and proper posture. Recreation is primarily active leisure, but also develops the personality. However, its primary purpose is to maintain or improve health and physical condition, and to maintain fitness, efficiency and coordination. Frequent physical exercise lowers cholesterol while having

a positive effect on the functioning of glands and internal organs such as kidneys, lungs, heart or liver (BORZUCKA-SITKIEWICZ 2006).

The natural environment is an ideal place to renew psychophysical powers. Everyday life can be put aside while communing with nature and it influences the psyche (SOŁOWIEJ 1992). Mountains are a special place to go for physical activity where the diversity of landforms creates many opportunities (SKIBICKI 2004). The Sudety Mountains are very varied in terms of terrain and culture and the area creates great opportunities for various forms of activity (MIGOŃ, TRACZYK 2002). Thanks to this, they have great potential for sport and recreation and are very popular (SZEWCZYK 2013).

Conditions for recreational activities in mountain areas differ considerably from those in the lowlands. In addition to the specialized equipment required, physical preparation is essential (WILMORE, COSTILL 2004) and recently, many amateur sport events have been organized in such places. Competitions of this type are recreational and the main motive for taking part is self-satisfaction and a willingness to test abilities, including in comparison with other participants. More and more such people, from different occupations are in fact in full-time work (DZIĘGIEL 2013).

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## 2. OBJECTIVE

The aim of the study is to present selected conditions for participation in amateur mountain races in the Sudety Mountains. In particular it concerns the determination of the intensity of physical activity associated with such participation. In addition, it presents the route characteristics of particular competitions, taking into account the natural conditions for which runners should be prepared. In addition, it contains data such as the length of specialized physical training, occupation and the size of their place of residence. Competitors taking part in the research proved that despite brief training they can attempt such demanding competitions.

To achieve this objective, there is the following research question: Which level of physical activity (KATCH, MCARDLE, KATCH 2011) is reached through the measured energy expenditure of women and men during amateur running competitions in the Sudety Mountains?

## 3. PARTICIPANTS

Research during amateur running competitions took place in the Sudety Mountains in 2015-17. Measurements of energy expenditure were made during competitions on 'medium' routes, averaging 19.2 km and with an altitude averaging 613.8 m. The study involved 40 women and 55 men; the average age for women was 35 (of which the youngest was 24 and the oldest 53) while for men it varied from 19 to 65 and the average was 37. The average body weight for women was 58 kg and for men 76 kg, the average height was 167 cm for women and 178 cm for men. Most participants came from the provinces of Dolnośląskie, Wielkopolskie and Śląskie, from small towns with



Photo. 1. Participants of the summer 'Run of the Piasts' - Jakuszyce 2017  
(Photo: T. Sarzała 2017)

populations up to 20,000 inhabitants (40%), or from those with up to 100,000 (40%). The respondents are generally 'white collar' (67%), most are office workers and include the self-employed. Among manual occupations are those related to road transport and industrial plants. Participants started their running between 1995 and 2016. One individual who has run since 1995 is currently 57, which means that he began running regularly after the age of 30. During the 2017 study several runners stated that they had trained for only one year, from 2016. They were in their thirties.

## 4. RESEARCH METHODOLOGY

Measurement of energy expenditure was carried out using a CALTRAC™ measuring device which is used both during exercise and at rest. It has an element called an accelerometer that analyzes the dynamics of motion by sending signals to a microprocessor calculating energy usage (MYNARSKI 2005). Those who agreed to make measurements received the device before the start and returned it after completing the run. CALTRAC™ is fixed to the waist. In addition, each volunteer completed a form of personal data.

Based on the energy expenditure measurements, the intensity of physical effort was calculated during one race. Results for women and men were averaged, taking into account variables such as time, weight and energy expenditure. On average, these values were calculated as kcal/min/55kg for women and kcal/min/65kg for men. On this basis, the athlete's fitness was assessed on the basis of the physical activity intensity classification according to Katch & McArdle 2011. The classification is shown on the table below (Table 1).

Table 1. Five levels of physical activity in terms of intensity of exercise

Level	Women (kcal/1 min/55 kg)	Men (kcal/1 min/65 kg)
Low	1.5-3.4	2.0-4.9
Moderate	3.5-5.4	5.0-7.4
Heavy	5.5-7.4	7.5-9.9
Very heavy	7.5-9.4	10.0-12.4
Unduly heavy	9.5-	12.5-

Source: V.L. KATCH, W.D. MCARDLE & F.I. KATCH (2011).

## 5. RESULTS

The study was conducted during ten competitions held in the Sudety Mountains from May to October, in 2015/16/17. Organizers, both in lowland and mountainous areas, prepare routes of differing distances.

Most runners have a choice of three: approximately half marathon, marathon or ultramarathon. For example, during the competition held in June 2017 in Karpacz, competitors had to choose between 17 km, 36 km and 55 km. Most amateur runners usually take the shorter distances, usually those who have been running for only a few years. For them participation in such a sporting event is a huge satisfaction, regardless of the result. The study was conducted among shorter-distance races: half marathon and less. The table below shows distance (km), altitude (m) and the ambient temperature during the competition (°C) (Table 2).

Table 2. Characteristics of the Sudety races

Competition, date	Distance (km)	Altitude (m)	Temperature (°C)
1. Wielka Pętla Izerska, 18.07.2015	21	444	25
2. Karpacz Maraton, 8.05.2016	21	640	20
3. 3x Śnieżka Karpacz, 25.06.2016	17	1,000	30
4. Bieg Piastów Jakuszyce, 6.08.2016	22	396	13
5. Super Bieg Świeradów Zdrój, 9.10.2016	15	630	6
6. Super Bieg Szlarska Poręba/Świeradów Zdrój, 10.06.2017	21	550	15
7. 3x Śnieżka Karpacz, 24.06.2017	17	1,000	20
8. Wielka Pętla Izerska, 22.07.2017	21	460	25
9. Bieg Piastów Jakuszyce, 26.08.2017	21.5	388	21
10. Super Bieg Świeradów Zdrój, 8.10.2017	15	630	8

Source: authors.

Races are accompanied by various conditions and the organizers keep the runners informed about the weather and possible changes. During the May events in the upper part of the mountains there is snow cover, and in the months from June to August there can be heavy rainfall and storms. In October the ambient temperature drops below 10°C, sometimes to 0°C. Strong winds can make the 'felt' temperature even lower. There can also be extreme heat. Nutrition points are located on the route at intervals. Mountain rescuers and medical staff watch for the safety of those involved.

The tables below show the results for energy expenditure in women (Table 3) and men (Table 4). They include information such as race number (from Table 2), age (years), weight (kg), time (min) and energy expenditure (kcal).

Table 3. Results for energy expenditure in women

No.	Race (table 2)	Age (years)	Body mass (kg)	Time running (minutes)	Energy expenditure (kcal)
1.	1	52	54	112	1,325
2.	2	43	60	145	1,743
3.	2	38	63	135	2,096
4.	2	30	57	118	1,797
5.	2	29	59	157	2,127
6.	2	25	55	130	1,908
7.	3	30	53	185	1,669
8.	3	27	53	175	1,594
9.	4	33	50	110	963
10.	4	34	65	130	2,073
11.	4	37	56	110	1,688
12.	4	31	60	125	1,905
13.	4	29	57	135	1,887
14.	5	38	63	90	1,374
15.	5	41	60	100	1,354
16.	5	35	58	95	1,353
17.	6	53	65	135	1,439
18.	6	39	65	130	1,620
19.	6	38	62	125	1,624
20.	6	40	64	130	1,690
21.	7	38	62	207	1,449
22.	7	29	56	174	1,429
23.	7	24	50	190	1,320
24.	7	30	55	165	1,513
25.	7	33	57	160	1,435
26.	8	41	60	117	1,395
27.	8	28	64	126	1,728
28.	8	42	62	170	1,951
29.	8	30	61	125	1,718
30.	8	39	60	145	1,953
31.	9	35	62	135	1,784
32.	9	36	57	135	1,624
33.	9	32	55	140	1,702
34.	9	25	52	98	1,567
35.	9	34	52	115	1,834
36.	9	32	51	122	1,930
37.	9	30	53	130	2,024
38.	10	38	65	108	1,313
39.	10	40	60	95	1,122
40.	10	37	59	102	1,314

Source: authors.

The mean values of energy expenditure, weight and time were used to determine the intensity of exercise during competitions for both sexes. The intensity of exercise was calculated as 11.6 kcal/min/55kg for women and 12.7 kcal/min/65kg for men (Table 5). The average energy expenditure in women was 1633 kcal, while among men, 1792 kcal.

Table 4. Results for energy expenditure in men

No.	Race (table 2)	Age (years)	Body mass (kg)	Time running (minutes)	Energy expenditure (kcal)
1.	1	37	74	98	1,440
2.	2	34	77	105	1,722
3.	2	33	64	93	1,704
4.	2	31	75	105	1,667
5.	2	26	76	100	2,102
6.	2	35	84	117	2,289
7.	2	30	75	138	2,161
8.	2	32	68	105	1,952
9.	3	26	74	140	1,719
10.	3	25	82	150	1,886
11.	3	28	72	154	1,738
12.	3	27	75	161	1,947
13.	3	39	72	117	1,435
14.	3	41	71	118	1,436
15.	4	46	73	115	1,929
16.	4	46	67	104	1,628
17.	4	47	86	155	2,021
18.	4	34	85	101	1,939
19.	4	33	85	115	2,779
20.	4	33	87	120	2,537
21.	5	65	75	105	1,184
22.	5	47	70	85	1,370
23.	5	48	91	112	1,629
24.	5	33	82	90	1,686
25.	5	37	72	85	1,443
26.	6	39	68	89	1,301
27.	6	55	62	95	1,287
28.	6	63	71	115	1,601
29.	6	37	66	110	1,645
30.	6	29	74	110	1,964
31.	6	44	84	120	1,711
32.	6	30	72	115	1,689
33.	6	32	75	120	1,760
34.	7	32	76	157	1,525
35.	7	28	71	151	1,491
36.	7	27	66	145	1,604
37.	7	33	85	161	1,818
38.	7	36	83	195	2,431
39.	7	28	71	155	1,736
40.	7	29	69	145	1,684
41.	8	42	85	122	1,988
42.	8	35	73	190	719
43.	8	37	80	114	2,052
44.	8	35	75	118	1,992
45.	8	39	79	120	2,096
46.	9	46	68	120	1,673
47.	9	39	78	101	1,613
48.	9	37	68	125	1,943
49.	9	28	85	110	2,182
50.	9	47	86	118	2,533
51.	9	30	82	120	2,142
52.	9	45	85	116	2,430
53.	10	51	84	96	1,570
54.	10	19	72	88	1,376
55.	10	28	75	90	1,658

Source: authors.

Table 5. Intensity of exercise

	Women	Men
Body mass (kg)	58.3	76
Running time (min)	133	120
Energy expenditure (kcal)	1,633	1,792
Average values	11.6 kcal/min/55kg	12.7 kcal/min/65kg

Source: authors.

The average distance run on all races was 19.2 km, while the average altitude was 613.8 m. The final figure refers to these average values. Taking into account the average results of all runners, it turns out that the value of physical exertion of women and men falls in the highest range of classification for physical activity, i.e. 'unduly heavy' (KATCH, MCARDLE, KATCH 2011) (Table 1). However, approaching the results individually, it turns out that for about 60% of the men it was 'unduly heavy', while for 21% 'very heavy' and about 18% 'heavy'. For women, for about 17% it was 'very heavy'.

## 6. CONCLUSION

Competitions in mountain areas are a great challenge for runners. Difficult natural conditions, variable weather and above all your own limits have to be dealt with. To even start involves long-term physical preparation and a proper diet. This article shows the range of physical exercise involved in amateur mountain races at half-marathon distance over mountainous terrain where the high ground is more difficult to overcome than in the lowlands. In spite of this, the popularity of these events is constantly growing, and among those who work full time and from different places, not only the highlands. Thanks to their popularity, more and more people want to take part which has implications for healthy lifestyles, with a focus on regular physical activity.

As a result of the data collected, it was shown that the intensity of exercise was high for both sexes, and although the races were at amateur distances, this involved a high level of physical activity for the runners. Based on the results of the research, the following proposition was formulated:

The vast majority of results on the energy expenditure of women and men during amateur running competitions in the Sudety Mountains show energy expenditure at the highest level of classification for intensity of physical effort, i.e. 'unduly heavy'.

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