Evaluating the Intensity of the
10-Minute Snatch Test
During a Hardstyle Kettlebell
Polish Championship

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Abstract

Aim. Over the last few years, an increasing number of people have started training with kettlebells (KBs) all over the world. Unfortunately, there is very little scientific data on the effect of training with KBs, and essentially, no research has been done on the various kettlebell sports which are dynamically developing. The main aim of this paper was to analyse the intensity of physical effort during the 10-minute Snatch Test (10-min ST) at the HardStyle Kettlebell Polish Championship (HSKPC). Our research also included an analysis of the contestants’ body composition on the day of competition.

Basic procedures. Ten male contestants and five female contestants were examined. Physical effort intensity was measured using Polar Team2 Pro. Body composition was evaluated with Tanita SC-330 immediately before the beginning of the competitions. The mean values of the analysed parameters in the study contestants were compared with the best male and female contestants of the Championship.

Results. Heart rate during intensive exertion for the 10 min ST was at a consistently high level (80-89% HR max) or very high level (90-100% HR max). Such a high HR was maintained for 98% of the exercise performance, and the mean relative energy expenditure was 14.4 METs among the women and 15.5 METs among the men. Analysis of body composition showed that participants of the HSKPC were characterized by an athletic build.

Conclusions. Even though the contestants lift relatively heavy loads during the 10 min ST (men 24 or 28 kg, women 16 kg), the effort can be described as an endurance test. Considering all the competitions taking place during the HSKPC and the results of the participants, it can be stated that these competitions are unusually demanding and require versatile physical fitness, as well as strength, endurance and coordination.

Introduction

The kettlebell, a weight which resembles a cannonball with a handle, has a growing group of supporters throughout the world. Most exercises with KBs are based on integrated, multi-faceted, dynamic movements requiring acceleration, braking and body stability. They are especially appreciated by functional trainers [1–4]. Some enthusiasts even encourage the use of KBs in physical therapy [5]. It has also been reported that training with KBs can relieve neck, shoulder and lower back pain [6].
Even though exercising with KBs has been long in Russia, and later in the former Soviet Union, it has only recently become popular. Undoubtedly, Pavel Tsatsouline, who propogated Hardstyle training, created StrongFirst and is the author of several books about exercises with KBs [7–10], was responsible for the dissemination of its popularity. However, his publications are rather methodological guides and not typical scientific reports.

During the last few years, some scientific studies have been conducted on working out with KBs and its influence on a person’s physical fitness. There are some reports about the impact of KBs on power and strength [6, 11–14], cardio-vascular performance [6, 15–18] as well as some biomechanical parameters [19–22]. According to Beardsley and Contreras [23], scientific literature on KBs is limited and therefore, there is a need to continue research on the use of this type of equipment and specifically, related exercises, in order to best implement them in training.

An overview of the previously mentioned literature shows that there are several studies regarding exercises with KBs. To date, kettlebell sport has not been researched. Many associations and sport federations exist throughout the world with various forms of competitions. They organize national competitions, European Championships and even the World Cup.

As already mentioned, thanks to P. Tsatsouline, the HardStyle method and StrongFirst training have become very popular among people working out with KBs. Put simply, these methods emphasize strength building by very precise movements to ensure safety and proper technique as well as combining muscles tension with biomechanical breathing. As in functional training, which is currently very popular, proper positioning and spine stability are focused on while exercising. The most popular exercises with KBs using HardStyle include: deadlift, swing, squat, clean, press and the Turkish get-up (TGU). For persons training with KBs, one of the most frequently performed exercises is the snatch [8].

A few years ago, as a result of popularity of the HardStyle training method and the establishment of well-structured StrongFirst clubs certified by P. Tsatsouline in Poland, a cycle of HardStyle Kettlebell competitions for amateurs and professionals was organized. It is notable that these nation-wide competitions are probably unique on a world-wide scale.

The main aim of this study was to determine the level of effort during the 10-min Snatch Test competitions of professional competitors during the HardStyle Kettlebell Polish Championship (HSKPC). This research also includes an analysis of competitors’ body composition on the day of competition. Furthermore, characteristics of the HSKPC competition as well as the original way of classifying the participating competitors are given.

The authors of this paper regard that this information can be inspiration for those who train using the HardStyle method to organize similar sport events on national and international levels.

Materials and Methods

Participants

The research was carried out during the 3rd HardStyle Kettlebell Polish Championship which was held on August 27, 2016 in Bielsk Podlaski, Poland. The study included 10 of 13 male competitors and 5 of 6 female participants in the professional category who completed all aspects of the competition. When the participants expressed their willingness to take part in the study, they were equipped with a pulse monitoring apparatus. The age range of the women was 24.0–33.0 years (27.8±3.8 years) and for the men 22.0–36.0 years (27.3±4.4 years). Calculated on the basis of the classical formula 220-age maximum pulse (HRmax) 192.0±4.0 bpm (187.0–196.0 bpm) and 193.0±4.0 bpm (184.0–198.0 bpm) was noted for the men and women participants, respectively.

The organization of the competition, characteristics of the competition and final classification

The men’s professional group competed in five events during the III HSKPC: the Military Press – raising the KB with one hand from a rack position, Pistol – squatting on one leg with a KB, Pull Up - with a KB attached to the waist, Turkish Get Up - getting up from lying on the back while holding a KB to a standing position, holding the KB over the head and returning to a lying position, 10-minute Snatch Test (10 min ST). The first four are for strength and involve one repetition with maximum weight (three trials). However, the 10 min ST is an endurance competition with repetitious lifting of kettlebells (20, 24 kg or heavier) with one hand over the head for 10 min. At any moment during the 10 min, the participant can set aside the KB or change hands. Women start in four events – omitting the pull ups and use 12 or 16 kg KBs for the 10 min ST.

In the HSKPC, there are no weight categories. Classification of participants in the individual and final events is based on allometric scales which are appropriately applied in weight lifting sports [24–27].

The allometric scale is calculated according to the following formula:

\[
AS = S \times M^{2/3}
\]

where:

- \(AS\) – allometric scale,
- \(S\) – weight lifted [kg],
- \(M\) – body mass of contestant [kg].
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For the 10 min ST (multiple lifts), the number of lifts performed to determine the indicator was also taken into consideration and multiplied by the AS value. The final result of the HSKPC contestants comprised the results from all competitions.

Measures

The exercise intensity during the last 10-min Snatch Test was measured with Polar Team2 Pro (POLAR®) which telemetrically monitored the heart rates of several individuals simultaneously while they exercised. A program which analysed the obtained data was included. With the Polar Team2 Pro, the exercise intensity is based on heart rate while exercising (ExHR) as well as information about the maximum value measured or estimated in each person (HR_{max}). With this information, it is possible to record how long the performance lasted in a specific intensity area. Data about heart rate during exercise is also used to estimate energy expenditure.

The following parameters characterizing exercise intensity and the accompanying energy expenditure were recorded for the studied participants: minimum heart rate during 10 min ST (ExHR_{min}), average heart rate during the 10-min ST (ExHR_{ave}), maximum heart rate during the 10-min ST (ExHR_{max}), time in zone 50-59% HR_{max} (ZT_{1}), time in zone 60-69% HR_{max} (ZT_{2}), time in zone 80-89% HR_{max} (ZT_{3}), time in zone 90-100% HR_{max} (ZT_{4}), absolute energy expenditure during the 10-min ST – amount of physical activity (AEE), relative energy expenditure during the 10-min ST – exercise intensity (REE).

Body height was measured with the RADWAG 100/200 OW altimeter. Body mass and composition were determined with the Tanita SC-330 analyser before the competitions started. The equipment was adjusted for typical body build. The following body parameters were measured and estimated: body mass (BM), body mass index (BMI), visceral fat indicator (VFI), fat rate (FR), fat free mass (FFM) and muscle mass (MM).

For all the analysed variables, the arithmetic mean (Mean) and standard deviation (SD) as well as their minimal (Min) and maximum (Max) values were calculated using Statistica 12.0 StatSoft, Inc. The mean values of the analysed parameters in all the studied subjects were compared with the best participants of the championship.

Results

The analysed minimal (ExHR_{min}), average (ExHR_{ave}) and maximum (ExHR_{max}) heart rates which were recorded while exercising during the competition’s 10-minute

### Table 1. Intensity characteristics of the 10-minute Snatch Test

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Participants</th>
<th>Women n=5</th>
<th>Men n=10</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExHR_{min} [bmp]</td>
<td>All</td>
<td>127.0±25.0</td>
<td>135.0±12.0</td>
</tr>
<tr>
<td></td>
<td>First place</td>
<td>139.0</td>
<td>144.0</td>
</tr>
<tr>
<td>ExHR_{ave} [bmp]</td>
<td>All</td>
<td>176.0±9.0</td>
<td>185.0±10.0</td>
</tr>
<tr>
<td></td>
<td>First place</td>
<td>189.0</td>
<td>193.0</td>
</tr>
<tr>
<td>ExHR_{max} [bmp]</td>
<td>All</td>
<td>184.0±9.0</td>
<td>195.0±10.0</td>
</tr>
<tr>
<td></td>
<td>First place</td>
<td>197.0</td>
<td>202.0</td>
</tr>
<tr>
<td>TZ1 [s]</td>
<td>All</td>
<td>1.4±2.2</td>
<td>0.2±0.6</td>
</tr>
<tr>
<td></td>
<td>First place</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TZ2 [s]</td>
<td>All</td>
<td>3.8±3.6</td>
<td>2.7±3.7</td>
</tr>
<tr>
<td></td>
<td>First place</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TZ3 [s]</td>
<td>All</td>
<td>8.2±5.8</td>
<td>10.3±5.5</td>
</tr>
<tr>
<td></td>
<td>First place</td>
<td>9.0</td>
<td>11.0</td>
</tr>
<tr>
<td>TZ4 [s]</td>
<td>All</td>
<td>231.0±265.2</td>
<td>84.2±113.4</td>
</tr>
<tr>
<td></td>
<td>First place</td>
<td>14.0</td>
<td>9.0</td>
</tr>
<tr>
<td>TZ5 [s]</td>
<td>All</td>
<td>355.0±273.3</td>
<td>502.1±119.6</td>
</tr>
<tr>
<td></td>
<td>First place</td>
<td>576.0</td>
<td>579.0</td>
</tr>
</tbody>
</table>

Legend:

ExHR_{min} – minimum heart rate during 10-minute ST, ExHR_{ave} – average heart rate during 10-minute ST, ExHR_{max} – maximum heart rate during 10-minute ST, ZT_{i} – time in zone 50-59% HR_{max}, ZT_{i} – time in zone 60-69% HR_{max}, ZT_{i} – time in zone 70-79% HR_{max}, ZT_{i} – time in zone 80-89% HR_{max}, ZT_{i} – time in zone 90-100% HR_{max}.
Snatch Test indicate the significance of its intensity. The values of the ExHRave and ExHRmax variables observed in the best participants were found to be in the upper limit of the variability of these parameters for all of the men and women (Tab. 1).

The evaluation of the length of physical effort in specific intensity zones showed that during the 10-min ST, high (TZ4) and very high (TZ 5) intensity dominated. This was especially evident in both winners of this competition, who with little effort, obtained medium (70-79% HRmax) and high (80-89% HR max) intensity with a distinct advantage of maximum intensity effort (90-100% HR max) (Tab. 1, Fig. 1).

Based on heart rates registered during the physical exertion of the 10-min Snatch Test, the absolute and relative caloric costs of the competition were determined. This required significant absolute energy expenditure (AEE) which averaged 170.2±21.3 kcal in women and 228.3±24 kcal in men. The high relative energy expenditure (REE) was, respectively, 14.4±1.8 METs and 15.5±1.4 METs, and indicates the significant physical exertion during the 10-min ST. Those who finished first in the competition had the highest or almost the highest REE. The male winners of the 10-min ST expended the greatest amount of energy in absolute terms (Tab. 2).

The study of of the HardStyle Kettlebell competition contestants found participants with an athletic build (BMI=24.7±2.7 kg/m² for women and BMI=27.0±2.0 kg/m² for men) to have a typical amount of fat cells for the general population, 28.4±2.5% for women and 17.4±1.5% for men. The studied athletes had low visceral fat indicators (VFI) and significant muscle mass (FFM and MM). The best female contestant was the shortest and at the same time the lightest, while the best male contestant was one of the tallest and heaviest (Tab. 3).
The main aim of the study was to evaluate the intensity of physical effort during the 10-minute Snatch Test of professional athletes at the HSKPC. The mean REE during the 10-min ST was 14.4 METs for women, and 15.5 METs for men. The profile of intensity for the best female contestant was 16.6 METs, and for the best male contestant, 16.4 METs. Considering the fact that the HR of athletes was 80-90% HRmax or 90-100% HR max for almost the entire time of the physical effort (97.8%) it can be stated that the physical effort was intense or very intense. It should be emphasized that the ExHR for the best female contestant was 90-100% HRmax for more than 96% of the duration of the exercise. Maintaining such a high HR during the 10-minute Snatch Test shows not only great physical intensity but also great endurance.

To help understand the exercise intensity during the 10-min ST, it can be compared to other forms of physical activity. For example, bike riding at a speed of more than 32.2 km/h correlates to 15.8 METs. Running 17.7 km/h (1 km – 3:24 min) involves an exercise intensity of 16.0 METs [28].

Schnettler et al. [18] carried out research similar to ours on 10 volunteers (women and men) aged 29-46 years old, experienced with kettlebell training. They examined the HR response, and EE during the standard 20-minute snatch workout using 12, 15 or 20 kg KBs, depending on the sex, body mass, level of physical fitness and experience. They found an ExHRave of 164±15 bmp, which equated to 93.0±4.5% of maximum HR. However, the EE of the subjects was on the level of 13.6±3.1 kcal/min.

The intensity of physical effort while exercising with KBs was also evaluated by Farrar et al. [15] and Husley et al. [16]. They determined the HR and EE during swings but not during snatches. Farrar et al. [15] studied a group of 10 men who performed two-handed swings for 12 min with 16 kg KBs. Although all subjects were recreationally active, only 1 had previous experience exercising with KBs. Their ExHRave was 165±13 bmp, which was 87.0 ± 6.0% of HRmax. In the studies conducted by Husley et al. [16] 13 individuals were studied (11 men and 2 women), 19-27 years old. The subjects were moderately trained but had no experience exercising with KBs. Their ExHRave was 165±13 bmp, which was 87.0 ± 6.0% of HRmax. In the studies conducted by Husley et al. [16] 13 individuals were studied (11 men and 2 women), 19-27 years old. The subjects were moderately trained but had no experience exercising with KBs. Their ExHRave was 165±13 bmp, which was 87.0 ± 6.0% of HRmax. In the studies conducted by Husley et al. [16] 13 individuals were studied (11 men and 2 women), 19-27 years old. The subjects were moderately trained but had no experience exercising with KBs. Their ExHRave was 165±13 bmp, which was 87.0 ± 6.0% of HRmax. In the studies conducted by Husley et al. [16] 13 individuals were studied (11 men and 2 women), 19-27 years old. The subjects were moderately trained but had no experience exercising with KBs. Their ExHRave was 165±13 bmp, which was 87.0 ± 6.0% of HRmax. In the studies conducted by Husley et al. [16] 13 individuals were studied (11 men and 2 women), 19-27 years old. The subjects were moderately trained but had no experience exercising with KBs. Their ExHRave was 165±13 bmp, which was 87.0 ± 6.0% of HRmax. In the studies conducted by Husley et al. [16] 13 individuals were studied (11 men and 2 women), 19-27 years old. The subjects were moderately trained but had no experience exercising with KBs. Their ExHRave was 165±13 bmp, which was 87.0 ± 6.0% of HRmax.
Since the physical exercise occurring during snatch- 
es or swings is intense, it can be assumed that this type of exercise should have positive impact on aero-
bic capacity. However, this is not entirely clear from the few studies performed to date. Beltz et al. [29] found 
a significant improvement of VO_{max} in an experimental 
group after 8 weeks of training with KBs compared to 
a control group. However, this was not confirmed by Jay 
et al. [6] in their similar 8-week research. Even though 
the length of both experiments was the same, the length 
and frequency of the training differed. The subjects un-
der the direction of Jay et al. [6] exercised 3 times per 
week for 15-20 minutes. Those under the supervision 
of Beltz et al. [29] exercised 2 times per week for 30-
45 minutes. Differences also involved training exercise, 
physical fitness, the selection of exercises, etc. Eckert 
and Snarr [30] feel that in spite of contradicting results 
of exercising with KBs, they can elicit a cardiovascular 
and metabolic response sufficient for improvements in 
aerobic performance. To improve the circulatory system, 
experts from the ACSM recommend exercises of moder-
ate (64-76% HR_{max}, 46-65% VO_{max}) or vigorous intensity 
(76-96% HR_{max}, 64-91% VO_{max}), lasting at least 10 min 
[31]. The cardiovascular responses to kettlebell routines 
included in this study would all be classified as at least 
of moderate- or vigorous-intensity.

In order to better interpret the nature of physical ef-
fort and the intensity of exercise during the 10-minute 
Snatch Test during the Polish Championship, it is worth 
looking at the contestants’ results. Women started with 
16 kg weights and performed 208 repetitions. The best 
did 239 repetitions. The men used 24 kg KBs and had 
a mean of 184 repetitions. The best result, based on the 
AS scale, was obtained by the only man who used 28 
kg KBs, with 210 repetitions. The results of research in-
dicate not only high performance but also a significant 
level of strength. For the average person, only lifting such 
KBs above the head once can be challenging.

Confirmation of the influence of exercises with KBs on 
the functional strength of subjects can also be seen in their 
results in other competitions (men – m, women – w): Military Press (45.7±6.4 kg – m, 21.0±4.2 kg – w), 
Pistol (48.8±11.1 kg – m, 25.0±7.8 kg – w), Pull Up 
(53.2±14.4 kg – m), Turkish Get Up (60.0±10.2 kg – m, 
34.0±4.0 kg – w). The best and female athlete in a given 
competition had the following results: Military Press (56 
kg – m, 26 kg – w), Pistol (68 kg – m, 36 kg – w), Pull 
Up (80 kg – m), Turkish Get Up (80 kg – m, 38 kg – w). 
The performance of diverse and difficult exercises with 
heavy weights can reflect a high level of overall fitness in 
terms of strength and endurance as well as joint stability 
and mobility, and coordination. This suggestion, however, 
needs to be verified and can be done with appropriate mo-
tor testing among Hardstyle contestants training with KBs.

At the moment, there are few studies dealing with 
the improving influence of training with KBs on muscle 
strength [30]. Manocchia et al. [13] showed that a 10-
week training period with KBs (two times per week) can 
significantly improve barbell bench press and clean and 
jerk results. These researchers suggested that KBs may 
be an effective alternative tool to improve performance 
in weightlifting and powerlifting. Jay et al. [6] found that 
after an 8-week period of training with KBs (3 times/wk 
for 15-20 min), which included the deadlift, two-handed 
and one-handed swing; the subjects had significantly in-
creased strength of the trunk extensors. Otto et al. [14] 
showed that training with KBs 2 times/wk for 6 weeks 
makes is possible to obtain significantly better results 
for the back squat, vertical jump and power clean perfor-
mance. Exercising with KBs significantly affects not only 
strength but also power. One can risk saying that train-
ing with KBs can have a greater effect on power com-
pared to strength because typically, kettlebell exercises 
(swings, cleans, snatches, push-presses, high-pulls) are 
performed in a ballistic manner in which the stretch-
shortening cycle is elicited due to the rapid concentric 
movement immediately following the eccentric counter-
movement [19, 21].

Apart from high performance and physical fitness, 
contestants training with the Hardstyle method must 
also have certain volitional traits which can influence 
their endurance while lifting the weights. Most impor-
tant is resistance to pain. With repeated lifts of heavy 
weights, there is often relatively deep damage to the skin 
of the palms.

While weighing the contestants on the day of the 
Polish Championship, their body composition was also 
evaluated. Even though this was not the main aim of our 
study, it can contain important information for future e.g. 
comparison of contestants in other sport disciplines or 
individuals not training with KBs professionally. Further-
more, the results present the body composition of ath-
letes training with the Hardstyle method during competi-
tions. Some of the body composition parameters of the 
contestants can be applied to the population norm. For 
this, normative data from the instruction manual of the 
measuring equipment was used (http://tanita.eu/help-
body fat ranges developed on the basis of research car-
ried out by [32] and the visceral fat indicator VFI, it can 
be stated that both female and male athletes were within 
the norm. However, their BMI was relatively high, with 
the mean for women being on the norm border, while for 
men, it was exceeded. This indicates the athletic body 
built of those professionally training KB HardStyle. It is 
worth noting that the best male and female contestants 
had FR and VFI less than the mean of all the participants. 
Interestingly, the best female contestant was the short-
est (10.2 cm shorter than the mean height) and weighed the least (9.6 kg less than the mean). Nonetheless, the best male participant was one of the tallest (2.8 cm taller than the mean) and only one other contestant weighed more than him (10.6 kg above the mean). This may indicate that short, light female contestants are predisposed to finishing near the top in the final classification of Hardstyle competitions, while a better predisposition was found in tall, well-built men with little fat tissue. This thesis is confirmed by the fact that both individuals won first place in the HSKPC.

Training with KBs is becoming more and more popular throughout the world, and at the same time, reports are not extensive, meaning that many areas of research can be investigated in the future. This is justified since there are reports stating that training with KBs is very promising and can improve overall physical fitness. Further research should include comparison of KB training with traditional equipment and methods of developing strength, power and endurance. It would also seem interesting to evaluate the metabolic effects of various KBs exercises (swings, cleans, snatches, jerks, etc.) in comparison to other typical physical exercises such as running various distances, biking, cross country skiing, etc. One must not overlook safety factors while exercising. Repetitive and long-term weightlifting requires appropriate precautionary measures and proper technique.

For the development of the kettlebell sport, it would be worth studying the sportspersons who train its various forms. Valuable information could be obtained by conducting measurements at sport events with additional factors such as stress and motivations which do not occur during training. Carrying out such research, however, is problematic and not always possible. It can only be done with permission from the contestant and the organizer of the sporting event. The measuring equipment can not hamper the execution of movement nor interfere with participation in competitions.

**Conclusions**

To summarize, it can be stated that the intensity of physical effort during the 10-minute Snatch Test at the sport event is high or very high. Even though the participants lift relatively heavy weights, the physical effort is of endurance nature.

Taking all the competitions during the Hardstyle Kettlebell Polish Championship into consideration, it can be stated that the competitions are unusually challenging and the contestants must be generally physically very fit, having the appropriate strength and endurance. Individuals competing in this form of rivalry should have an athletic body build with relatively little fat tissue.

**References**


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