The role of sport event specific motor skill tests in the performance results of professional hammer throwers

Abstract of the PhD thesis

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1. INTRODUCTION

Hungary is well-known to be a highly successful country in the hammer throw Olympic event for which, in no small part, the Hammer Throw TrainingCentre led by PálNémeth (1. photo) inthe town of Szombathely, is responsible.My personal experience as an athlete and coach inthe club greatly contributed to my understanding of PálNémeth's coaching work and methods.

1.PálNémeth

In the areas of selection, development, and achievement there are discernible divisions within theoretical approaches (Bloom, Child, Garnder). Furthermore, there is a lack of consensus in the practical fieldwork as well. The general absence of a dependable method for selection and development in the throwing sports also negatively affects Hungarian hammer throwing in particular. This subject is of prime significance as all sport events require an objective selection and development system in order to serve as a foundation for their continuous successes.

Within the scope of my doctoral thesis, I aimed to analyze the most successful throwing centre in Hungary and the work accomplished by PálNémeth with the intention of making a positive contributionto the issues of selection, development, and achievement. In my paper I also intend to call the attention of other clubs and coaches to the example of PálNémeth and how his sustained and persistent work eventually translated into unparalleled successes. Additionally, my goal is to explore those factors and attributes which clearly demonstrate the necessary steps to be taken for the future development of

hammer throwing in Hungary. Finally, I will touch upon one unwelcome phenomenon in hammer throwing, namely, the loss of many talented and promising young athletes from the sport itself.

2. AIMS

The primary goal of our research was to identify what measure the various motor skill tests and assessments contribute to the development and successes of throwing athletes. Within the span of nine years, we annually examined the results and the predictive potentials of six skill tests. Based on the data gathered, it was our goal to identify the intervals between and methods of motor skill training, which are required for the achievement of internationally recognized results in throwing athletics. Besides this, we also attempted to define what athletes and coaches understand by the terms selection, development, and achievement based on similarities and disparities within the confines of this sport event.

In light of our research we can propose the following:

1. The ideal age for the selection of throwing athletics and events is adolescence.
2. The choice of throwing athletics and events can be optimized if physical characteristics and coordination, and motor skill tests are relied on.
3. Throwing tests, though in varied measure, can predict future hammer throw performance.
4. The jump test, similarly, though in varied measure, can predict future hammer throw performance.
5. Weightlifting tests, though in varied measure, can predict future hammer throw performance.
6. According to throw coaches, the predictive capacity of motor skill tests is higher in the case of throwing tests than jump and weightlifting tests.
7. In selection and development, throw coaches primarily consider body structure during adolescence, signs for the ability to learn the right movement, and the results of motor skill tests.
8. For performance and achievement throw coaches mainly judgethe outcomes of motor skill tests, mental balance, and high-level positive emotional factors and willpower.

3. METHODS

3.1.Sample

We examined various motor skill tests of internationally recognizedathletes (aged between 19 and 27) at the Dobó SC at Szombathely for a duration of nine years. The selection criterion of the athletes was the achievement of at least an eighth place finish at the European or World Athletics Championships or at the Olympics. At this club we found six athletes who fulfilled such requirements. The cumulative mean of their best throws was 81.92 m, which is an unparalleled accomplishment, even internationally within a single club.

Annually, we digested the results of six surveys, which translated altogether into54 surveys in nine years, with 576 annual data entries or 5,184 entries throughout the whole project (plus additional competition results).The uninterruptedly compiled data stream included the results of measurements of body composition, throw, jump and weightlifting tests(see Table 1).

In addition to the analysis of these motor skill tests, we also conducted semi-structured interviews with successful coaches who could claim to their credit athletes with a minimum of a third place finish in national and a minimum of an eighth place finish in international competitions. I was able to interview the coaches of Dobó SC (n=4) and also the excellent trainers who, upon the division of the club, migrated to the Haladás SC (n=3), as well as some other select coaches (n=2). Interviews were also undertaken with two successful male and two females athletes (n=4) who all have outstanding Hungarian and international results.

SURVEYED CATEGORIES	ASSESSMENT TESTS	NUMBER OF SURVEYS
BODY COMPOSITION	1. height 2. bodyweight	Altogether 54, 6 surveys annually for 9 years
THROWS	3. hammer throw 7.26 kg 4. hammer throw 9 kg 5. 8 kgkettlebell 2 arm sideways backward throw 6. 16 kgkettlebell 2 arm sideways backward throw 7. 8 kg kettlebell 2 arm overhead throwbackward 8. 16 kg kettlebell 2 arm overhead throwbackward	Altogether 54, 6 surveys annually for 9 years
JUMPS	9. standingquintuple jump 10. standing triple jump 11. standing long jump	Altogether 54, 6 surveys annually for 9 years
WEIGHTLIFTING EXERCISES	12. snatch 13. power clean 14. deep squat 15. box squat (100^{o}) 16. benchpress 17. high pull	Altogether 54, 6 surveys annually for 9 years

Table 1:assessment tests

3.2.The methodology used in the surveys

Description of motor skill tests

The hammer throws were executed with 7.26 and 9 kg weights using the same technique as in competitions. Weight throws were measured with 8 and 16 kg kettlebells. These were done in a wide stance position with two arms on one side turned backwards following the swing with the torso turning toward the direction of the throw. The overhead throw had to be executed with two arms, also in a sideways wide stance position after lowering the centre of gravity and losing balance. Following the release of the kettlebell, stepping back was permitted.

The standing quintuple and triple jumps were initiated with a jumping off two legs, jumping alternatively with both legs and then landing with two legs in the sand pit.The

standing long jump was also accomplished with a jumping off two legsupon gaining momentum and landing with two legs in the sand pit.

The snatch and power clean exercises,administered for the measurement of maximum strength, were done by our hammer throwers with techniques well-known from weightlifting. The deep squat was done to form the maximum angle, while for the box squat specially designed boxes were used. The members of the throwing team used the same boxes for their regular training that were employed for the survey.

Benchpress was measured on a flat horizontal bench. The lowering of the weight had to be done with bent elbows,then pressed upward;then the weight was replaced on the rack without the use of a hip drive. For the high pull exercise, the weight had to be up to neck height from an arched position.

The performance of the athletes was assessed in terms of the common standards used in athletics. The precision of the throwing and jumping exercises was guaranteed with the use of certified sports measuring tapes within 1 cm accuracy. After warming up,each thrower had three attempts in each exercise.

Anthropometric data was recorded by standardized equipment. Body weight was measured in each survey withina 0.10kg level of accuracy, with height measured every year within a 1 cm level of accuracy. The weightlifting exercises were measured within a 5 kg accuracy range.

As we dealt with the athletes of theDobó SC,it is natural that the same coaches worked with every test subject. Every participating hammer thrower trained in the same environment with identical methods. Their agesmatched as well, since, as indicated previously, each one of them was tested from the age of 19.

Description of the interviews

In our research we conducted semi-structured interviews with successful and accomplished throwers and their coaches with the goal of gathering personal information and experience from the best in this event.During the interviews we covered the topics of motor skill tests, selection, development, and achievement. We were particularly interested in the relationship between these essential topics on the one hand, and the success and performance of the athletes on the other.

3.3.The assimilation and analysis of data

From the relatively large pool of more than 5,000 entries we calculated the following statistical indicators: mean, spread, minimum, maximum, variable coefficient, and linearcorrelationcoefficient.We carried out cause-effect analyses between the variables with regression equations calculated for individual athletes and training years (on a cumulative basis as well). For the calculations we utilized StatSoft'sStatistica v11 program.

The analysis of the interviews was accomplished through qualitative methods. We searched for concurrences and divergences in the responses of successful coaches and athletes, which were then categorized, analyzed and presented in such manner.The most important aspect of the interview process was the focus on knowledge and experience,which was continuously stressed for both the involved coaches and athletes.

4. RESULTS

4.1.Body composition

Average height: 189.33 cm. The value of correlationcoefficient(R= 0.8855) proves that there is a strong link between bodyweight and hammer throwing performance. To achieve throws of 80 mor more, a minimum of 185 cm in height and 105 kg in weight is necessary. Our results clearly demonstrate that for hammer throwing, from the perspective of body composition, height and bodyweight are the most important factors.

> "You have to be minimum 185 cm; if you are shorter you cannot remain internationally competitivein the long-term."(N.Zs.)
>
> "With my weight less than100 kg,I was unable to exceed 80 m throws." (G.T.)

4.2.Throw exercises

There seems to be a close correlation between the results of the 9kg and the 7.26 kg hammer throws (R=0.8301). Among the throw exercises, by viewing the training years, we could find the strongest link (R= 0.9246). With the use of the 1 meter long heavier hammer a 1.869 meter improvement was recorded. We found a 10 m divergence between the results of 7.26kg and 9kg hammer throws.

Thus, it can be stated that the two hammer throw events are the most important exercises, and the athletes' development is better served by forward releasesthan by reverse throws. There is a lack of consensus among coaches as to which weight is optimal for the completion of the exercise:

> "In my opinion the closest correlation is between throwswith the 9kg hammer and with the two arm sideways reverse throws." (N.L.)
>
> "I can say that the two hammer throw exercises are the most significant, followed by the throws executed with thekettlebell, and finally, the weightlifting exercises." (G.T.)

A 1 m improvement with the 16 kg kettlebell throw translated to an8.80 m improvement in hammer throw results. Throughout the duration of the entire 9 year training period, we found a stronger link than with the lighter weight.

The stronginterconnectivity of the four throw exercisesis only present during the first year of training. In the final training years improvements and more obvious linkagesonce againmanifested. We could ascertain that throw exercises with heavier weights show a closer connection with hammer throw performance.

> "I believe the 16 kg exercises make the biggest impact." (G.T.)

4.3.Jump exercises

For the jump exercises the regression data points were as follows: standing quintuple jump: R=0.2416; standing triple jump: R=0.1687; and standing long jump: R=0.4034.

The connections between them are well-established. Strong links are present only with the box squat exercise. Performance parallels were uneven, which is due to the fluctuations in the bodyweight of the athletes.Those who excelled in jumping were less effective in throwing, or those whose throwing was impressivewere not so in triple and quintuple jumps.

> "The standing long jump demonstrates most clearly dynamic, explosive strength that the legs of any successful thrower in any event must bring forth." (SZ.L.)
>
> "When I was in my best form I used to do superbly in standing long jumps, but the other two did not go so well." (G.T.)

4.4.Weightlifting exercises

The correlation coefficient of R = 0.8754 shows a definitively strongconnection. In light of the results it is obvious that in each training year there was marked development here. In weightlifting the execution technique is of crucial significance, especially in the case of snatch. We found strong correlations throughout the whole nine training years between snatch and kettlebell throws. The strongest connection was observed between the results of hammer throwing and snatch exercises, which is clearly substantiated by the opinions of the coaches.

> "In hammer throwing just as in weightlifting exercises what you need is maximum explosive strength." (K.L.)

A 10 kg improvement in the deep squat (R = 0.8007) translated toa 3.38 m increase in hammer throws. In the case of the box squat (R = 0.8118),a 10 kg developmentmeant 2.41 m in increased throws.

The squat exercises showed a strong linkage during the entire duration of the study. The initial results of the first training year were exceedingly high, which indicates that from the age of 16 the athletes had undergone a serious strength training routine as they already achieved a 220 kg average.This proves PálNémeth's beliefthat by the age of 16 the young athletes must be able to throw around 60 m. From the results obtained we can surmise that the athlete with the best squat result was not at the top in the jump exercises.

> "As I see it, the two hammer throw exercises are the most important, followed by the throws done with a kettlebell; then comes weightlifting." (G.T.)

4.5.Selection and achievement

The following is an aspect of PálNémeth's work he has carried out in terms of recruitment since 1977:

> "I have contacted PE teachers in public schools 548 times and I was able to recruit 348 students, and 32 of them joined the club."

The coaches, almost in unison, concurred that the optimal age for selection is between

12 -15 years of age.

> “I would search for 13-14 year-old kids who are taller and more muscular in physique.” (Gy. R.)

Throw coaches deemed body type as one of the most significant criteria for selection.

> “The ideal athlete should be tall and slender with long arms and a low centre of gravity.” (N. L.)

The coaches are in agreement that the necessary and appropriate maximum and dynamic strength results are to serve as prerequisites for selection.

> “Anybody who is of promise is expected to reach 180-195 cm in height, but those at the age of 13-14 already at least 175-185 cm tall will reach an adult body weight of95-115 kg.” (N.P.)

The coaches also placed emphasis on the continuous development and improvement of technique. The right coordination skills of body movements were deemed indispensable as well.

> “It is essential that the particular athlete should have physical attributes and technical skills that could both be well developed.” (S.Gy.)

To attain optimal performance, the potential for learning new movements quickly is also of significance.

> “It is a significant factor that the athlete should be able to absorb any type of movement with ease besides having above average physical strength and speed.” (N. Zs.)

5. CONCLUSIONS

Upon examination of the four throw exercises we can conclude that there exists a stronger link between throws with heavier weights and hammer throwing. Accordingly, throws with 16 kgkettlebells impact hammer throw results more than those with 8 kg ones. This is a notable conclusion since a number of coaches consider drills with lighter weights as more beneficial exercises.

The results achieved in hammer throwing are also influenced by numerous factors, which means that any test model can only give a partial explanationof the alterations in the athletes’ performance.

We can conclude in line with our results that with proper foundation five years of intensive training work with a huge number of throws and repetitions was needed to attain the level of technical skill that permitted radical improvements in performance.
Likewise, optimum strength levels can be attained with proper foundation following years of training work. Results indicate that only from the sixth training year does the high execution of throwing technique move into the forefront.
One of the merits of our research is that in throwing athletics, so far, no long-term research has been carried out which has allowedthe making of recommendations to coaches based on the statistical analysis of the results of internationally recognized athletes and interviews with successful trainers.

5.1.Verification of our hypotheses

We assumed (H-1) that the ideal age for selecting throw athletics and the individual event is adolescence. This assumption was substantiated by the opinion of the interviewed coaches as they almost unanimously stated that the optimal age for selection is between 12-15 years.Without doubt a career in hammer throwing can be started much earlier taking into consideration the physical development of the young athlete and the weight of the hammer. However, it is not performance, but rather the pursuit of a versatile training regime that should be at the core of athletic work at this age.
We assumed (H-2) that the successful choice of selecting throw athletics and the optimal individual event is based primarily on body composition, motor skill tests, and coordination abilities.Our assumption proved correct, as according to Hungarian coaches,body composition is one of the crucial selection criteria; proper coordination of movement is also indispensable,while some considered the results of motor skill tests as the most significant.
We assumed(H-3) that motor skill tests in throwing, though to an uneven measure, still can predict potential success and achievement in hammer throwing. Our hypothesis was fully validated by the research data collected.
We assumed(H-4) that jump exercises measuring motor skills can, even though to an uneven degree, forecast future hammer throwing performance.This assumption was only partially substantiated by the research data since we found only a weak or even negligible link between jump exercises and hammer throw results. Only the standing

long jump and the box squat showed any meaningful connection with hammer throw performance.

We assumed(H-5) that weightlifting exercises,although to various degrees, nevertheless give a good indication of hammer throwing performance. Our hypothesisin this case as well was only partially validated since we found no connection between benchpress and hammer throw results.

We assumed (H-6) that according to coaches the predictive capacity of motor skill tests in the case of throw exercises is more pronounced than with jump and weightlifting ones. Our claim was proven right as coaches also emphasized throw exercises to be of elemental importance in training.

We assumed(H-7) that coaches in the cases of selection and development mainly look at adolescent body type, the ability to learn body movement, and the results of motor skill tests. Our hypothesis proved valid since the coachesprimarily emphasized body type; movement learning and coordination abilities were also enumerated.

We assumed(H-8) that coaches,for the purpose of achievement and performance, would principally focus on the results of motor skill tests, mental balance, as well as emotional and willpower characteristics. Our expectations were confirmed as all of the above proved clearly valid during the interviews.

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