



HOW DID WE GET HERE?

By James Major, Davis Diamonds Gymnastics

Drs. Sands and Tilley have independently discussed how our sport of gymnastics became what it is today. But we have little objective, quantitative information; instead mostly legal proceedings. Some information from our competition might help us understand how we got here. Apparently, in the D.D.R. (Deutsche Demokratische Republik, the former East-Germany) they knew how gymnastics was changing, and long before we did. Our women didn't beat the D.D.R. team until the 1988 Olympics. Our men never did. In the 1988 Olympics, the D.D.R. team, men and women, were one of the top three gymnastics teams in the world. The D.D.R. collapsed as a nation in 1989, Germany was re-unified, and the D.D.R. sports science "skunk works", the Research Institute for Physical Education (FKS) became the Institute for Applied Training Science, University of Leipzig. At the risk of revealing how long I have been around, I would like to summarize some data on the development of gymnastics between 1963 and 1987 that could give insight into how we got where USA Gymnastics is today, particularly for younger coaches who weren't active back then.

In "Principle Directions for Increasing the Effectivity of the Gymnastics Training System", Dr. Jürgen Krüg presented data that, while now very old, is not widely known, but highly relevant and informative about how the sport of gymnastics developed as it has (Krüg, 1987). Dr. Krüg was a scientific staff member of the National Gymnastics Team of the D.D.R. His paper was published in 1987 in a classified journal that was only available to D.D.R. elite coaches and officials with government security clearance. Dr. Krüg's report is an important, historical document. As you read what follows, keep in mind that much was written over thirty years ago. What follows is a translation and summary of his report.

Principle Directions for Increasing the Effectivity of the Gymnastics Training System

In 1987, Dr. Krüg observed that the sport of gymnastics had objectively undergone a substantial development in performance and difficulty between 1961 and 1986. This was his conclusion from annual analyses that were done by the D.D.R. scientific support staff of the D.D.R. of their own and international elite using an objective system of points assigned for difficulty, execution, and consistency. Please see Fig. 1. showing the age and how long it took to learn selected tumbling skills. We can see a number of clear trends between 1963 and 1985. More difficult acrobatic skills were practiced. These more difficult skills were learned

by younger and younger gymnasts. But less and less time was taken to learn these basic skills. The age of selection to national training programs gets progressively younger.

Age in Years

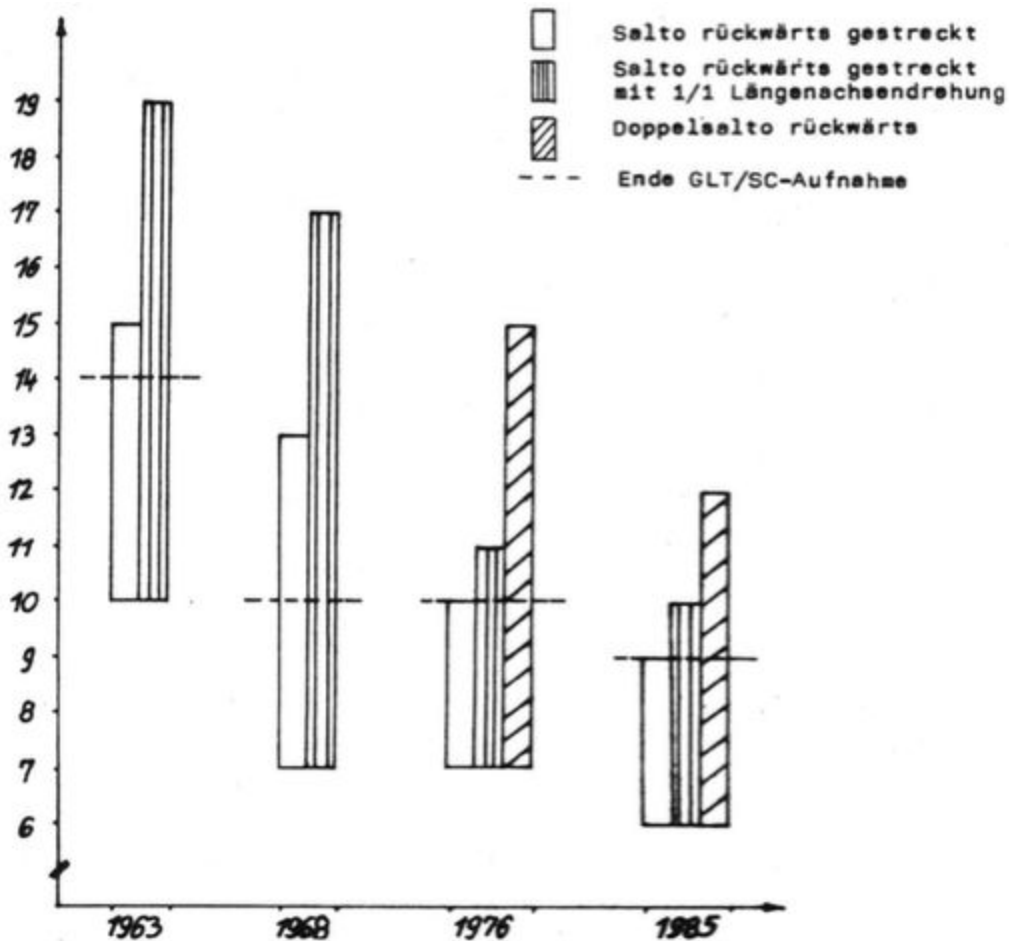


Fig. 1. Change in learning time for selected acrobatic floor exercise skills by D.D.R. female gymnasts between 1963 and 1985. The white column is layout back somersaults. The column with vertical lines is for full twisting layout back somersaults. The hatched column is for double back somersaults. The bottom line of the columns is the age at which the gymnasts begin to practice this skill. The dotted horizontal line across each group of columns shows the age at which gymnasts were selected for centralized training. From Krüg, 1987

In Dr. Krüg's opinion, such progress was due to development of the training system. Key elements in this development were

- Increasing the amount of practice
- Beginning gymnastics specific training at a younger age
- Younger athletes in all levels of the national team

The increase in annual training hours of women in the D.D.R. and U.S.S.R. is shown in Fig. 2. The data for male gymnasts was similar. Between 1963 and 1986, the amount of training hours in the gym per year more than doubled. Even more interesting, for ten year olds, the total hours in the gym in a year went from 400 to close to 1400. By 1982, five-year-old female gymnasts were training 600 hours per year in the Soviet Union. Fig. 1. indicates how the age at which systematic gymnastics training started was lowered and lowered. Fig. 1. also shows how the gymnasts in centralized training became younger and younger.

Annual Training Time in Hours

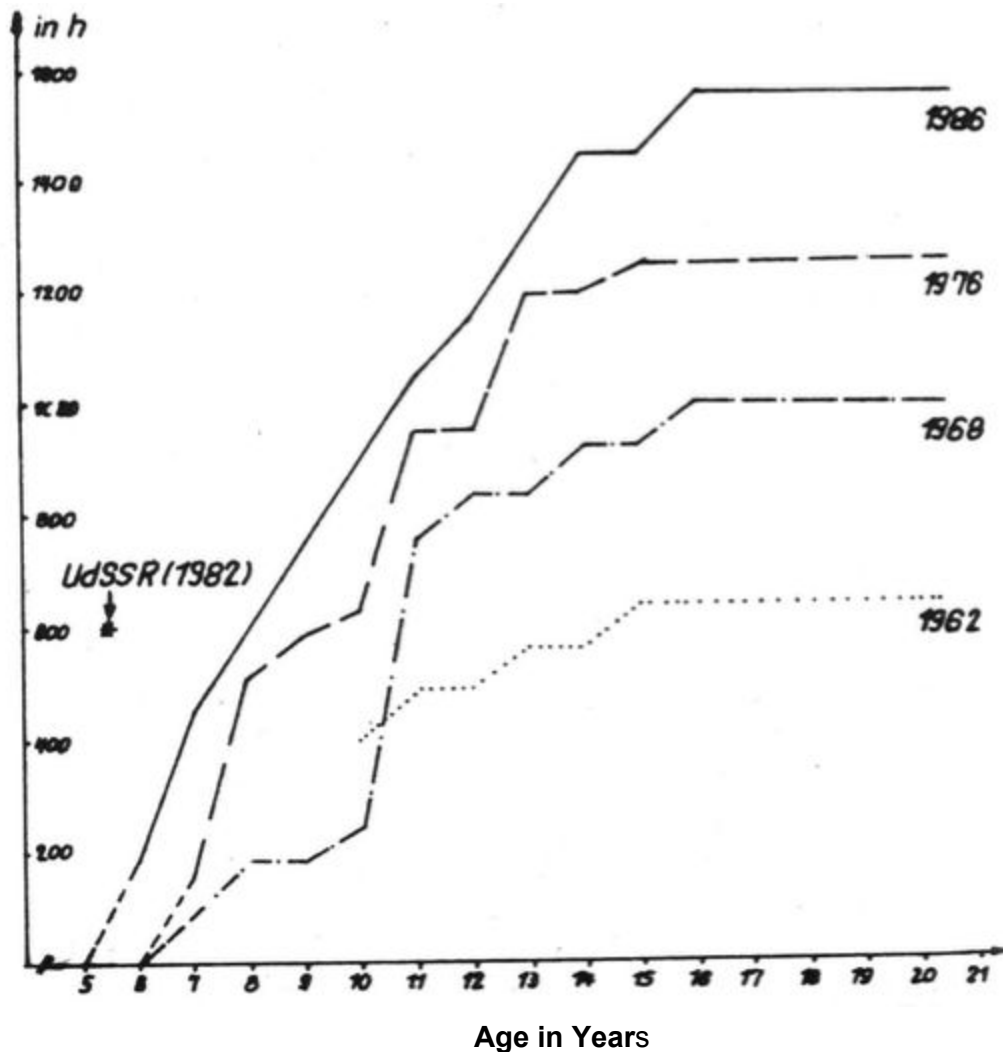


Fig. 2. Development of training amount of female gymnasts in the D.D.R. and Soviet Union (UdSSR) in hours per year, by age of the gymnast in years between 1962 and 1986. From Krüg, 1987

According to the analysis of Krüg, the main trends were

- Based on a progressive development of all performance determining factors, the all-around performance of women and men was improved.
- Gymnastics routines became more original, with greater technical virtuosity, aesthetically better, and, with few exceptions, more consistently performed.

Dr. Krüg identified two general trends:

First - Gymnastics had become more and more acrobatic. To an ever increasing degree, spectacularly difficult skills had been created in all events. This was particularly evident in the development of airborne skills. By 1987, these skills made up more than 50% of the total difficulty value.

Second - The value of gymnastics as a spectacle had increased. Elements of dance, ballet, and art were used to increase the interest of the public.

Both of these trends were amplified by changes in the Code of Points, the interest of the fans, and television. In the leading gymnastics nations, these trends in the development of performance were based on improving the long-term system of performance development by means of more effective learning processes. This progress was strengthened by a better coordination between developing pre-requisites and learning, and the rapid introduction of special equipment to the training process (trampoline, strap-bar, video, special tumbling strips). At the same time, this rapid development had some negative side effects:

- Medical problems did not fail to appear. The number of athletes increased who were not able to tackle the increased demands, dropping out, in particular children and adolescents.
- Countries without a big population had increasing difficulty preparing complete national teams for the most important competitions.

These were big problems for particularly the women's team of the D.D.R. This applies particularly to the National Team, but as well to the Junior Championship of Friendship team, a championships for Junior National Teams of Eastern Europe.

The causes of rapid performance improvement with high drop-out rates

Analyzing the training systems of the D.D.R., Soviet Union, and China, three characteristics were common:

- The time in the gym had increased for all developmental levels;
- In order to exploit the most favorable age for learning gymnastics, gymnastics training was started at a younger age, and the age of peak performance had become younger;
- More training, at a younger age, was associated with greater use of more training aids (trampolines, strap bars, video, special tumbling strips, etc.).

Increased time in the gym

The increase in time in the gym during year-round training in the D.D.R. is illustrated by the data in Fig. 2. In other countries, development was pushed even harder. Already by age 5 and 6, more hours were spent in the gym in the U.S.S.R. For example,

particularly talented girls trained five to six times per week, 2.5 to 3 hours per day already in 1982. Compared to 1962, a gymnast in 1987 had approximately twice as many training hours available for high performance training. Through just the increased training time, the amount of repetitions was proportionately increased.

The process of making the gymnasts younger

Apparently, with younger athletes you can make more dynamic changes in the training system. This development began in the 1970s with the Roumanian group around Nadia Comnenici. However, this development was not immediately recognized as having a future. However, for the 1986 Junior Championship of Friendship, the upper age limit for boys was set at 18 and 15 for girls, but undercut by a number of teams by two years. This is evidence that this development had not yet peaked.

Specific training at a younger age

More gymnastics specific training at a younger and younger age is illustrated by the data in Fig. 1. According to Dr. Krüg, by 1987, female Soviet gymnasts age 12 were mastering significantly more difficult skills than a tucked double back somersault. They could already perform all of the most difficult skills of those days international elite. My wife and I saw this first hand when the club we were coaching in Norway organized a Junior Championships for Northern Europe the week after the 1987 FIG World Championships in Rotterdam, with junior national teams from Iceland, Norway, Sweden, Finland, and the Soviet Union. The Norwegian judges who had just officiated finals at Worlds, and then judged our Junior meet a week later, told us several of the Soviet juniors would have been finalists in Rotterdam given the difficulty of their routines and execution. The all-around junior champion vaulted a double-twisting Yurchenko over a side horse, a beam finalist dismounted with a tucked full-in, and a bars finalist dismounted with a double front $\frac{1}{2}$ out from a front giant.

Dr. Krüg had further examples to illustrate this development. Erika Zuchold was the first female to perform a back handspring on the balance beam in 1964; in 1987 this skill was the D.D.R. standard for 9 year olds. Klaus Köste was 1972 Olympic Vault Champion with a handspring front. In 1987 this vault was performed in the D.D.R. by twelve year old boys. Dr. Krüg pointed out that some skills require dealing with peak forces ten times greater than body weight. Of course, this is the same for younger and older gymnasts. But more specific training at a younger age did not have advantages for performance development of every skill group. For some basic skills, for example giant swings (men), vaults, and some ring skills, a quadrupling of the time spent resulted in reducing the training age by only six months to a year. This particularly concerns skills with a big strength component. With such skill groups, costs and benefits must be fundamentally balanced against each other.

By 1987, there was no question that the increase in time in the gym, beginning at a younger age, with more specific training, by younger gymnasts, had been important factors in the rapid development of gymnastics. At the same time, these factors had some negative side effects.

Increasing proportion of athlete's with delayed growth and maturation

A late developer is defined as a child whose growth and physical maturation is slower and/or later than average children. Dr. Krüg wrote, "According to Hoffman's (1985) evidence based on body morphology data, the retardation effect is primarily due to the combined effect of school and sport and not, as was often believed, due to the selection process. During the course of developmental training, the degree of delay increased, although more among the girls than the boys. This delayed development must be given attention because biologically younger athletes cannot tolerate the training load of normally developing athletes." This quote is important because this issue has been intensely debated both in USA Gymnastics and internationally. Here Dr. Krüg states that their evidence indicates heavy work load of these young gymnasts delayed their growth and maturation. Moreover, these delayed gymnasts were more orthopedically liable to over-use injury.

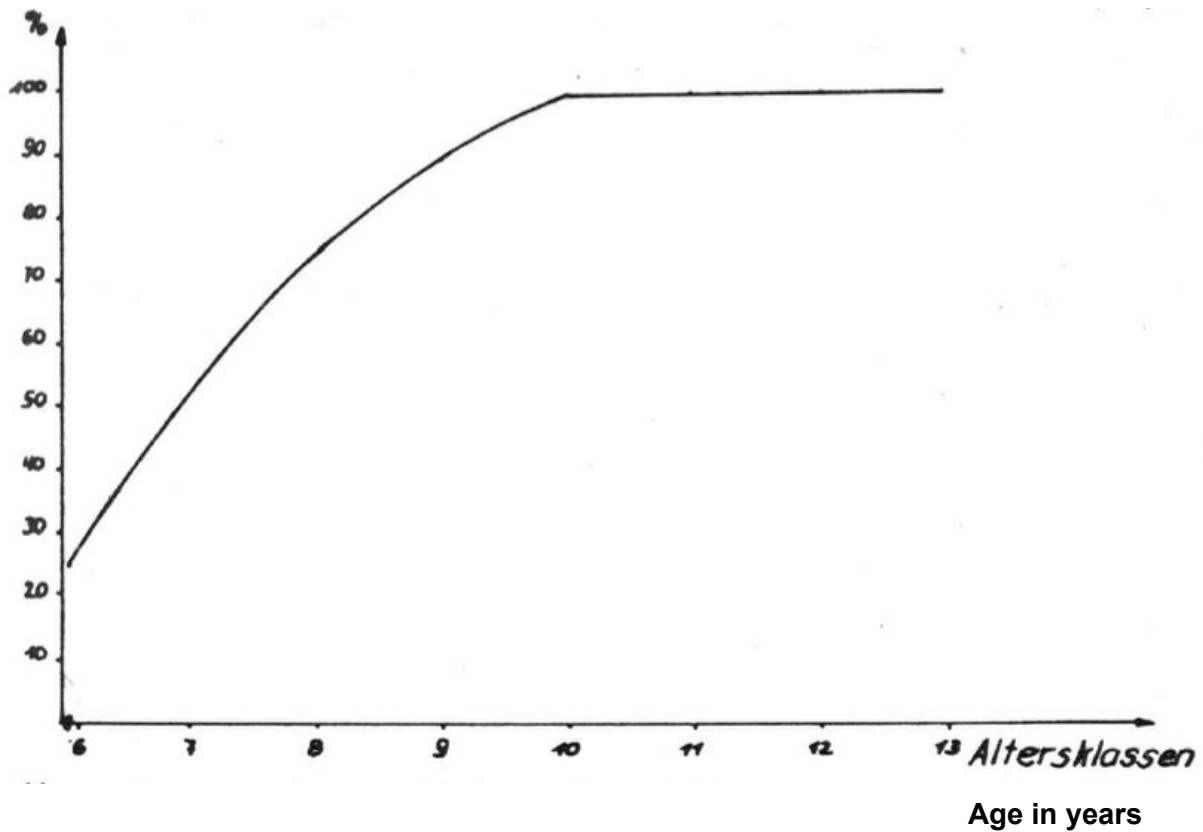
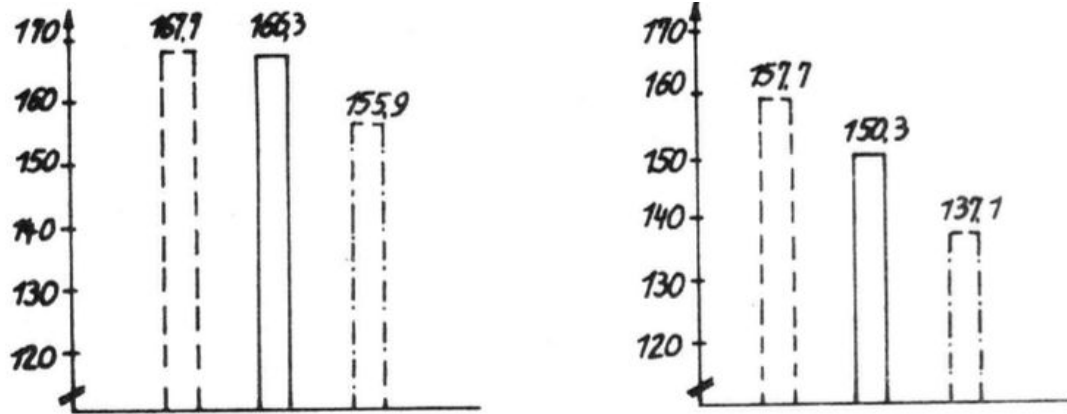


Fig. 3. Percent of late developers among D.D.R. female gymnasts in 1985. Note that by age 10, all gymnasts were late developers (from Hofmann, 1985)

Changes in Morphological Characteristics

Among male gymnasts, body length and body weight have hardly changed. In contrast, since the 1970s there is a trend towards shorter and lighter female gymnasts. (Fig. 4.)

Body Length	
Male	Female
Body length in cm	Body length in cm



Body Weight

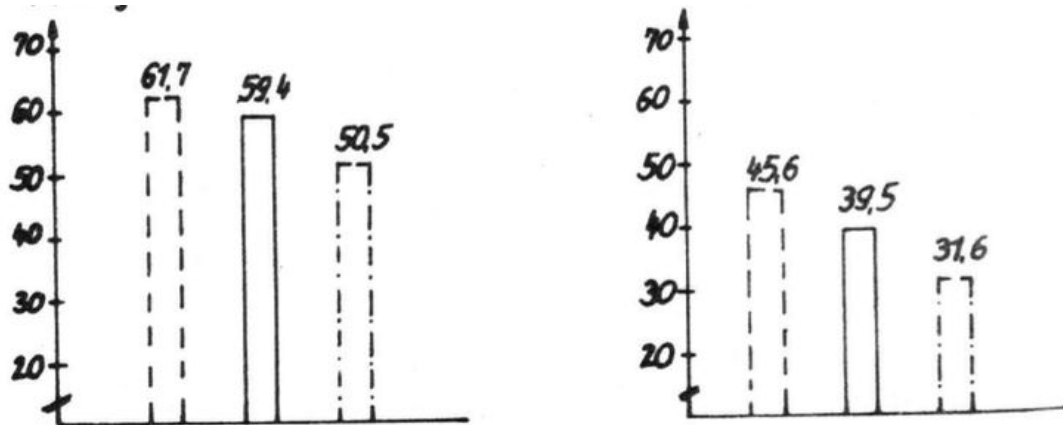


Fig. 4. Body length and weight of male (left) and female (right) elite gymnasts. In each triplet of columns, the left most column is the average of the three best teams in the 1976 Olympic Games, the middle column is the average of the three best teams in the 1985 World Championships, and the right-most is the average of the Soviet Union team at the 1986 Junior Championship of Friendship.

During the 1986 Junior Championship of Friendship, Schmidt (1987) was able to record the important anthropometric data of all of the competitors. The following facts emerged:

- The Soviet boys team, but above all the girls, had a much greater amount of active body mass, in other words, they were more muscular and better prepared for high performance. This was in spite of having a much younger girls team.
- Typologically, the Soviet gymnasts were different from the D.D.R. gymnasts. The girls' ratio of shoulder width to hip width was typical for men. We have to assume that either this gymnast type came out on top

from a large number of gymnasts because they were more able to take the training, or more drastically, such girls were purposely selected.

Changes in National Team membership

The previously presented changes in the training caused changes in the National Team of the D.D.R. In the National Team as well as in other countries, the drop-out rate had increased in the elite and development teams. The careers of elite gymnasts became shorter and shorter. Changing the training system became necessary to solve this problem of increasing performance while reducing the drop-out rate.

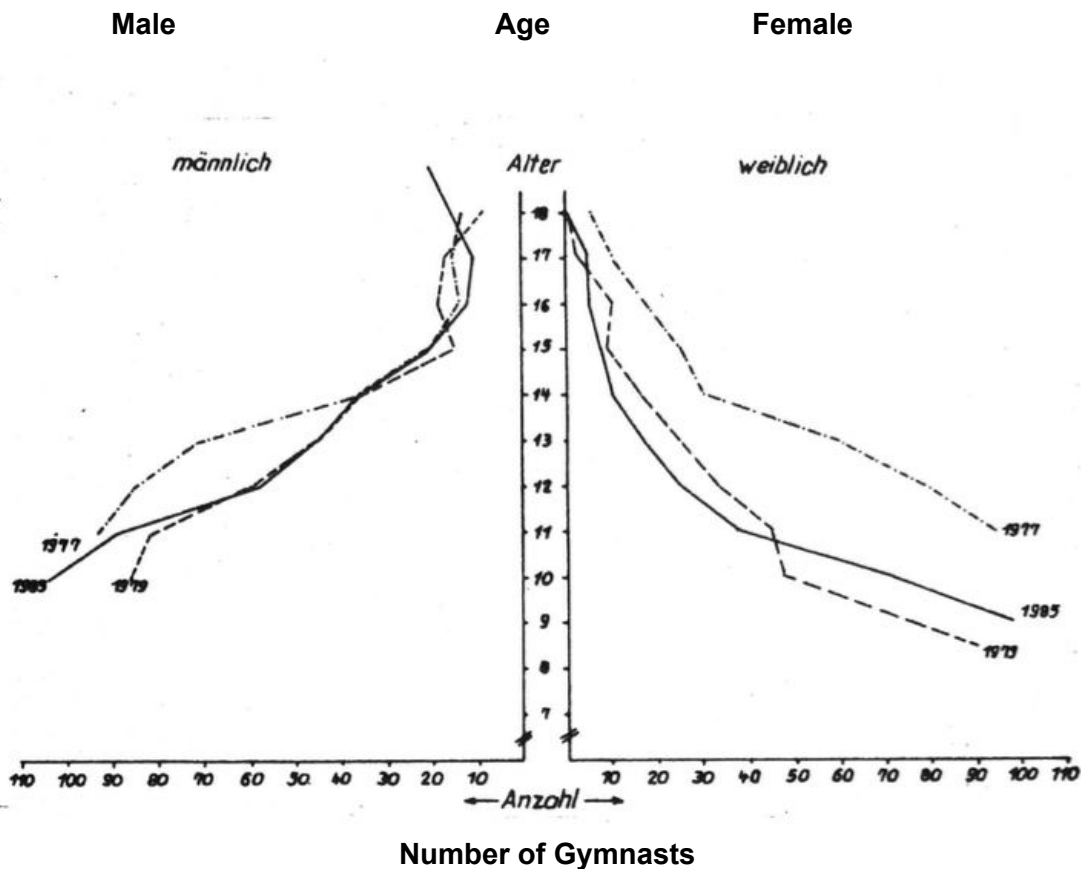
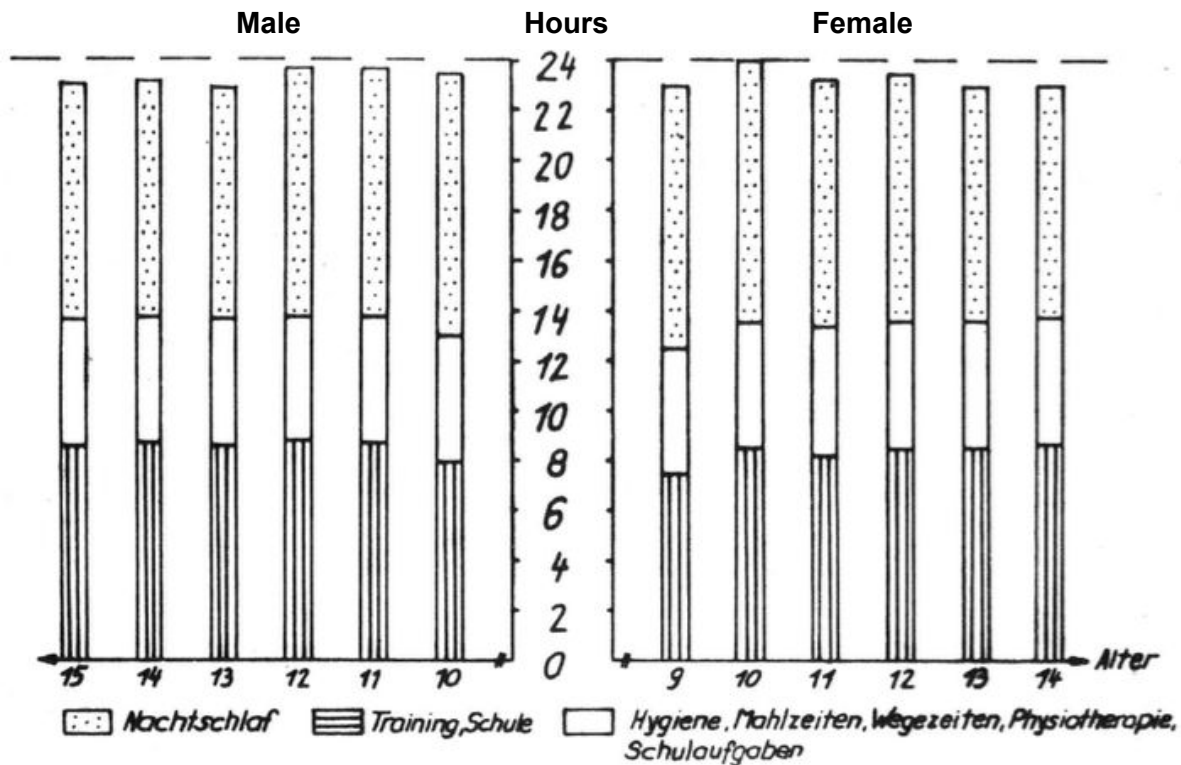


Fig. 5. The D.D.R. National Team pyramid, male on the left and female on the right, during 1977, 1979, and 1985. In 1977, the youngest girls in the national program were almost twelve years old and there were about 100 of them. By 1985, the youngest were about nine and there were also about 100 of them. A similar development occurred in the men's team. From Krüg, 1987.

Fig. 5. shows changes in the composition of the National Team pyramid in 1977, 1979, and 1985. Even if the D.D.R. succeeded in feeding more children into the training system, at the same time, the number of drop-outs increased significantly. There were two important causes:

- A greater proportion of the children were not able to meet the gymnastic requirements;
- Another group, including some very high performing gymnasts, had to be demoted because of insufficient orthopedic ability to tolerate the training load.

This evolution in the National Team pyramid was more extreme for the women because here the trend to younger and younger athletes was more extreme. The time spent was shortened for foundational and developmental training. In reaction to performance development internationally, high performance training methods were introduced at younger ages. Investigations by Fröhner et al. clearly indicated increased medical training injury among females, but also males (Fröhner et al., 1982, 1986). Training injury appeared at younger and younger ages, descending into the 3rd and 4th grade, the age of entry into centralized training, and even into the basic training in the child training centers (TZ).



Age

Fig. 6. Distribution of a 24 hour day spent by gymnasts in the centralized training system for various activities at selected ages. Ages 10 to 15 are shown for boys and 9 to 14 for girls. The lowest part of each column with the vertical bars is the amount of time in school and training per day. The middle, white part of each column is the time per day spent on personal hygiene, eating, traveling, physiotherapy, and homework. The upper part of each column with the dots is the amount of time in night-time sleep. Fröhner, et al., 1982

Increase Effectivity - Necessary Changes and Theoretical Approaches

Like other D.D.R. Olympic Teams, gymnastics benefited from an internationally exemplary high performance sports system, with elements like talent identification and selection, the Spartakiade movement, KJS (Training centers for children and adolescents) support, and performance development over four stages of long term training. However, by 1987, many countries had comparable systems, consequently ending any advantages for the D.D.R. Moreover, the gymnastics federations of the U.S.S.R., Roumania, and China had gained an advantage because these countries had several varieties of KJS, and most importantly, special schools for gymnasts (or at least for all the acrobatic sports). Dr. Krüg roughly estimated that they gained a two year advantage on the D.D.R.

Dr. Krüg went on to discuss what needed to be changed in their training system. What was not needed to increase the effectivity of the D.D.R. training system was copying the systems of other countries. The problems of the D.D.R. were those of a small national population competing at the top in both summer and winter Olympics. These are different problems than for example USA Gymnastics, which has more athletes competing in NCAA Division I gymnastics alone than the entire elite program of Russia and D.D.R. combined. Instead, the D.D.R. had to find specific and highly effective changes for their own situation. Dr. Krüg presented six ideas:

1. The basic problem in further development of the training system was how to integrate a faster development of performance with a reduction in the drop-out rate.
2. The objectively increasing complexity of this problem, a faster development of performance with a reduction of the drop-out rate, interdicts the common and unchanged practices of increasing time in the gym, making the team younger, and more specific training at a younger age.
3. The dialectic approach consists of making use of the younger team, and to a certain extent the increased training time, but with different emphasis in the training.
4. A clear improvement in effect could be achieved by means of all of the quality factors of intensification. In other words, shortening learning time, and reducing the number of attempts, by continually improving the means and methods of conditioning and learning. Here, computer supported information is a highly effective means of improving the means and methods of training. It is important to spread computer supported information into the training process.
5. Above all, an improvement in effect can be achieved with a better integration of measures to increase tolerance to training load with training that improves performance.
6. We should bring under quality and quantity control, not just the elements of the training load, but the entire training system of the National Team Performance pyramid.

Dr. Krüg went on to recommend specific changes to the D.D.R. gymnastics training system. By 1989, the West-German gymnastics scientist Dr. P. Brüggeman wrote that gymnasts train so much that further improvement in performance can only be achieved by improving the quality of the training and not the amount. Improving the quality of the training can only be achieved with knowledge of the biomechanics of the skills (Brüggemann, 1989). The

way many of our gyms have been equipped with delay video screens for fast feedback is an example of the direction that Dr. Krüg recommended for the D.D.R. in 1987. If you have seen the computerized gymnastics training centers with digital instrumented apparatus in Germany and Holland, you have seen what Dr. Krüg was recommending. Most of our gyms are far from this kind of technical support, but that is another discussion entirely. Dr. Krüg also recommended a research project directed at the question of a period of accelerated learning during pre-puberty. Here in the USA, we have been increasingly successful for the past three decades without direct government funding. But we had no one like Dr. Krüg, with his education, experience, and above all access, to objectively analyze what was happening. In the absence of objective information, coaches have to intuit the best way forwards.

CONCLUSION

Between 1963 and 1987, the level of acrobatic performance in gymnastics developed, as the gymnasts were getting younger and younger, shorter and shorter, and lighter and lighter. More and more specific training methods were introduced at younger and younger ages. At the same time, drop-out and injury rates were increasing. An increasing percentage of gymnasts were delayed in their growth and maturation. Dr. Krüg and his co-workers believed that the combined load of school and more specific gymnastics training at a younger age was causing the development and maturation of the gymnasts to be delayed. They also believed that delayed physical development made them more susceptible to injury. That more D.D.R. gymnasts were developmentally delayed and that more gymnasts were demoted or dropped out is clear. However, exactly how these two effects are related is not clear. Dr. Krüg stated it was not selection, which is an important contribution to a controversial subject. We do not have developmental records on our gymnasts, so objective data available like in a country with universal health care is not available. But more than likely, we experienced a similar increase in proportion of gymnasts more susceptible to injury and drop-out that Krüg saw in the D.D.R., just for many years after them.

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