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# THE ROLE OF DYNAMOMETRY AND ANTHROPOMETRIC MEASUREMENTS IN ASSESSING THE PHYSICAL FITNESS OF GYMNASTS

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### Abstract

This article examines the significance of transitioning from subjective evaluation to objective measurement methods in rhythmic gymnastics. The research highlights the critical roles of anthropometry and dynamometry as primary metrological tools in monitoring an athlete's physical fitness and body formulation. By analyzing parameters such as body composition, growth dynamics, handgrip strength, and back muscle strength, the study demonstrates how quantitative data minimises human error and enhances training efficiency. Furthermore, the integration of data-driven decisions, statistical norms, and video analysis tools enables coaches to substantiate their conclusions, prevent injuries, and individualise training programs. Ultimately, the article establishes that combining the coach's intuitive experience with objective sports science elevates the training process to a scientifically grounded pedagogical experiment.

**Keywords:** Rhythmic gymnastics, anthropometry, dynamometry, objective measurement, subjective assessment, body composition, handgrip strength, pedagogical control, data-driven decisions, supercompensation.

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### Introduction

Dynamometry and anthropometry are the primary metrological tools in sports medicine and pedagogy, enabling the evaluation of an athlete's physical condition through quantitative (numerical) indicators.

#### 1. Anthropometric Measurements Modeling Sports Form

Anthropometry is the systematic measurement of body dimensions and shape, including the assessment of body fat percentage and height-to-weight ratio. These metrics allow athletes to visually track their physical condition on a graph.

In rhythmic gymnastics, it is utilized for the following purposes:

**Body Composition Assessment** the ratio of fat mass to muscle mass (body composition) is one of the most critical indicators for gymnasts. Excess body fat negatively impacts movement speed and the execution of Body Difficulty (BD) elements.

**Growth Dynamics Monitoring** identifying imbalances between bone growth and muscular development in young gymnasts (to understand temporary declines in coordination during growth spurts).

**Proportion Analysis** the ratio of limb (arms and legs) length to body mass directly influences the aesthetics of movement and the technique of apparatus handling.

#### 2. Dynamometry Monitoring Strength Abilities

Obtaining numerical data on handgrip strength or back muscle strength. This provides an exact fact (e.g., “has a strength of exactly 40 kg”) rather than an approximate estimation (“is relatively strong”).

Dynamometry is a method used to measure the strength (physiological capacity) of muscles. In rhythmic gymnastics, it is carried out in two main forms:

**Handgrip Dynamometry** the strength of finger and palm muscles is essential when working with apparatus (hoop, ball, clubs, and ribbon). This indicator determines the gymnast's apparatus control (grip strength).

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Back (Core) Dynamometry evaluates the strength required to maintain the gymnast's body in a vertical position, balance, and the support force during leaps and jumps.

Dynamometric indicators reveal where the athlete stands within the process of supercompensation (the law of workload and recovery). For instance, a steady decline in dynamometric scores indicates that the athlete is experiencing overtraining.

### 3. Integrated Monitoring Model

In scientific research, these tools can be enhanced using the following formulas and systems:

- a) Correlation Analysis Determining the relationship between anthropometric changes (weight gain or growth) and strength indicators.
- b) Normative Indicators Developing “model characteristics” tailored to each specific age group.
- c) Forecasting Predicting the long-term physical fitness level of a gymnast based on dynamometric data.

### 4. The practical recommendations for the study are as follows:

Indicator	Measurement Tool	Assessed Quality
Body mass	Caliperometry / Bioimpedance	Functional mobility
Handgrip strength	Hand dynamometer	Object control
Back muscle strength	Back dynamometer	Static and dynamic balance

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Dynamometry and anthropometry signify a transition from subjective assessment (the coach's perspective) to objective measurement. Training programs designed based on these data reduce the gymnast's risk of injury and enhance training efficiency. Transitioning from subjective assessment to objective measurement means abandoning the coach's visual appraisal (subjective view) and shifting toward a pedagogical and biomedical monitoring system based on precise numerical data (facts).

Monitoring an athlete's physical development is not merely about measuring weight, but rather analyzing body composition (fat and muscle percentage) and body mass index (BMI). It involves measuring the body's response to workload through dynamometry and pulsometry.

The video analysis system does not rely on the coach's memory; instead, it examines every degree and coordinate of the movements using software (or a standard slow-motion mode) applied to the video footage.

Systematization of measurement results (a metrological approach). To ensure an objective measurement, merely collecting data is insufficient; it must be processed correctly:

- establishing norms developing statistical average indicators (model characteristics) specific to each age group (e.g., 8–10 years, 12–14 years).
- tracking dynamics (monitoring) analyzing the obtained data in a graphical format. This clearly displays the athlete's growth curve.

Injury prevention if a decrease in muscle strength is detected through dynamometry, the coach can timely reduce the training workload and prevent serious injuries.

1. Individual planning instead of a one-size-fits-all program, an individualized training regimen is designed based on measurement results to target and improve each gymnast's specific weaknesses.
2. When athletes see their progress reflected in data such as increased strength or refined technique their psychological readiness and goal orientation are

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significantly enhanced. This transition not only improves performance outcomes but also elevates the gymnastic training process to the level of a scientifically grounded pedagogical experiment.

Understanding the difference between subjective and objective approaches in rhythmic gymnastics (or any other sport) is crucial for enhancing training quality and accurately evaluating performance outcomes. The following table and explanations help to differentiate these two concepts from both scientific and practical perspectives.

Feature	Subjective Assessment	Objective Measurement
<b>Primary Source</b>	A coach's experience, intuition, and vision.	Precise measurement tools, figures, and facts.
<b>Accuracy</b>	Dependent on the human factor (high probability of error)	Metrological accuracy
<b>Reliability</b>	Subject to change depending on the situation and mood.	Yields the same result upon re-measurement
<b>Example</b>	The athlete is performing well today	The athlete's strength measured 35 kg on the dynamometer.

1. Subjective evaluation is a conclusion formed through a person's emotions, personal opinions, and experience. A coach's intuitive insights often help detect the athlete's psychological state (motivation, signs of fatigue). However, this approach is imprecise, as two different coaches may evaluate the same movement

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differently. Because it is based on personal opinion, it is difficult to scientifically justify.

2. Objective evaluation is a system of precise data that can be verified by anyone, independent of external factors (such as the coach's mood or personal perspective). For example, observing a movement in slow-motion and measuring the gymnast's leg angle or body position in degrees.

3. Objective data substantiates the coach's conclusions to both the athlete and parents (for example, Why is this athlete not ready for the competition right now?).

4. When conducting research, you rely on facts (data-driven decisions) rather than subjective opinions.

5. Objective measurements help predict future performance. While the subjective approach is an art (coaching experience), the objective approach is sports science (pedagogical control).

### Conclusion

In conclusion, this study highlights the critical importance of transitioning from traditional, subjective coaching evaluations to precise, objective measurement methods in rhythmic gymnastics. By integrating metrological tools such as anthropometry and dynamometry, coaches can abandon modern reliance on visual appraisal and replace it with a biomedical and pedagogical monitoring system rooted in hard, numerical facts. The research demonstrates that measuring comprehensive data such as body composition (fat and muscle percentages), handgrip strength, and back muscle strength provides concrete indicators that eliminate human error and accurately reflect an athlete's physical capabilities. Furthermore, implementing data-driven systems, statistical norms, and video analysis allows for precise tracking of growth dynamics, early identification of overtraining (the supercompensation cycle), and effective injury prevention. Ultimately, while subjective evaluation remains a valuable coaching art for

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assessing an athlete's psychological state, it must be balanced with sports science. Merging a coach's intuitive experience with objective scientific data not only substantiates decisions to athletes and parents but also enables highly individualized training programs. This systematic approach elevates the rhythmic gymnastics training process from mere estimation to a scientifically grounded pedagogical experiment that significantly enhances performance and goal orientation.

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