INDIVIDUAL OPTIMISATION OF BODY COMPOSITION

Brief Information for Players, Coaches, Medical Staff, and Officials

In a weight-sensitive sport: peak physical performance is directly linked to optimal body weight and body composition. Body fat is predominantly stored in adipose tissue (AT). The B-mode ultrasound method **(SUM**: **Standardised Ultrasound Method**) developed in Graz in recent years, enables for the first time the measurement of athletes' body fat – more precisely, adipose tissue – with an accuracy that meets the demands of elite sports. The method was standardised in cooperation with the IOC Medical Commission. **Changes in adipose tissue (SAT) as small as 0.1 kg can reliably be detected in athletes.**

An excess of adipose tissue reduces the ability to accelerate, decreases jumping performance, and negatively impacts endurance. It is self-evident and noticeable to any athlete that physiologically unnecessary "extra weight" of one, two, or several kilograms of adipose tissue significantly diminishes the individual's attainable physical performance, which, in turn, has a highly detrimental effect on the overall performance of a team. This becomes particularly evident when several athletes on a team are not within the range of their optimal body composition. The increased fatigue associated with carrying additional "ballast weight" during intense competition or training can also lead to cognitive and neuromuscular effects: winning or losing is often a question of mental focus. Furthermore, the risk of injury increases with higher passive body mass due to the greater strain on joints.

In football, for example, optimizing the adipose tissue (which contains the dominating part of total body fat) positively impacts a range of players' abilities and skills, thereby improving the team performance as a whole. **Improvement of physical abilities:** acceleration, sudden changes in direction, the ability to perform numerous intense sprints over 90 or 120 minutes, running speed, endurance, and jumping power. **Improvement of cognitive abilities due to reduced fatigue:** Precision of movements, accuracy of shots, awareness of the current game situation (avoiding "tunnel vision"), anticipation of the next phase of play, early optimal positioning for upcoming actions, nonverbal interaction with teammates, and decision-making regarding tactical strategies.

Regarding adipose tissue, many elite athletes in weight-sensitive sports fall within the **Low-II**, **Low-I**, and **lower Medium-I** categories. Higher values are associated with reduced individual performance. In principle, transitioning from too high levels to optimal values can be straightforward, but it does require adjustments in certain lifestyle habits, a balanced diet (including the reduction or avoidance of sugary drinks, fructose, or alcohol) - tailored to training and competition demands. The physiological basis is the principle of energy conservation: when the body uses less energy than it receives from food and beverages, the proportion of adipose tissue increases - and thus the total body fat, which is the amount of all non-polar lipids in the body. The classification values for athletes (**Table 1**) provide general guidelines for personal orientation, but individual circumstances must also be considered. Not everyone finds it equally easy to achieve and maintain 'optimal body fat'; and what the 'optimum' is may differ from one athlete to another; however, unnecessary adipose tissue impairs optimal performance.

On the other hand, extremely low values (**Low-III**) can also negatively impact performance and jeopardize the health and resilience of athletes, as adipose tissue is an important endocrine organ that influences many physiological processes. These medical issues and their prevention are discussed in the scientific literature under the term REDs (Relative Energy Deficiency in Sport; **British Journal of Sports Medicine**, 2023, 57:1148-1160, open access).

Table 1: REFERENCE DATA of SAT

The DI-reference values for athletes are rounded values at the percentiles p. For the derivation of reference values from percentiles of data sets used, see [1].

Abbreviations: subcutaneous adipose tissue (SAT); sums of SAT (DI); percentiles (p), male (M); female (F).

		D_I-reference values **Athletes**			D_I-reference values **General Population**	
SAT - classes	p [%]	M [mm]	F [mm]	p [%]	M [mm]	F [mm]
Low-III	15	<8	<32	15	<8	<32
Low-II	25	8-12	32-40	25	8-12	32-40
Low-I	50	12-20	40-56	70	12-32	40-70
Medium-I	70	20-32	56-72	90	32-60	70-90
Medium-II	80	32-40	72-80	95*	60-110	90-130
High-I	90	40-60	80-100		110-160	130-160
High-II		60-110	100-130		160-200	160-200
High-III		>110	>130		>200	>200

[1] Müller, W., Ahammer H., Müller T.M. et al.: Accurate measurement of adipose tissue, and body shape correction of the BMI. In: Müller, W., Fürhapter-Rieger A., Ahammer H. & Ackland T.R. (edts.): Beyond BMI: Accurate Measurement of Body Composition - a change of paradigm. Chapter 3 (IASMS, Graz, 2025), ISBN: 978-3-200-10400-6.

Body weight, in relation to height, is often determined using the Body Mass Index (BMI). We use an improved version of the BMI, the **Mass Index (MI)**, which additionally takes **body shape** (sitting height, leg length) into account. The **NISOS-BCA** (**B**ody **C**omposition **A**nalysis) protocol also includes **sport-specific anthropometric data.**

The significance of these accurate measurements of body composition and of anthropometric variables lies in the fact that athletes can assess their personal values – in relation to the team's values, and in comparison with other elite athletes – and, based on this, can motivate themselves to work towards their **optimal body composition**, which is a crucial factor **for achieving personal peak performance.**

Kind regards
The IASMS and NISOS teams

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8-meter-sprint:

1 kg less fat makes the 22 cm