

# DOPING AND PUBLIC HEALTH



THE ENDOCRINE SYSTEM  
SUBSTANCES  
DIETARY SUPPLEMENTS  
PREVENTION

It is Anti-Doping Norway's impression that the use of doping agents has increased among youth over the last decade, and we have recently noticed increasing concern about doping abuse from healthcare professionals, police, child welfare authorities, families and others. Police cases show that the production, distribution and sale of doping agents appears to involve organised crime.

We see a great need to intensify and promote preventive anti-doping efforts in society in general, and among young people in particular. Experience shows that there is a lack of basic knowledge about doping and the consequences of abuse, and more and more professional groups are requesting information. Abuse of performance-enhancing drugs, especially anabolic androgenic steroids, is no longer reserved for subcultures at certain gyms but exists at most fitness centres and has taken root in a multitude of social communities and circles. It is therefore important that the police, Customs, Armed Forces, Correctional Service, Health Services, schools, fitness centres, parents and other public employees have sufficient knowledge and expertise to identify signs of possible abuse so that they can initiate a good dialogue with abusers at an early stage and help with effective monitoring of vulnerable individuals.

Abuse of performance-enhancing drugs is associated with serious health risks and harm. Anti-Doping Norway considers it very important to raise awareness of doping among young people, but also try to prevent at-risk youth from starting doping. It is essential that those who interact with users and potential users have a high level of knowledge, and that they cooperate across agencies, businesses and organisations. We have acknowledged that doping abuse is a complex and multi-faceted issue that must meet with a coordinated, comprehensive effort, where knowledge and expertise are crucial for success. With all of this in mind, we have prepared this handbook for you who interact with young people and adults who are either considering doping or have already established patterns of abuse.

The handbook details the most important groups of substances associated with doping, and includes a discussion on both primary effects and adverse effects. This is absolutely necessary knowledge for facilitating communication with those using such substances. We want to guide you in seeking further knowledge and encourage you to contact us at Anti-Doping Norway when you feel it is necessary.



*Fredrik Lauritzen*  
*Exercise physiologist, PhD*  
*Director of Prevention and Public Health*

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## AUTHORS



**Fredrik Lauritzen**

*Exercise physiologist, PhD*

Director of Prevention and Public Health, Anti-Doping Norway



**Per Wiik Johansen**

*Chief physician, MD PhD, Specialist in clinical pharmacology*

Head of Department, Pharmacology Department, Oslo University Hospital



**Morten Heierdal**

*Project team member*

Antidoping Norge



**Christine Helle**

*MS Nutrition physiology*

Author and lecturer



**Dominic Sagoe**

*PhD, Associate Professor*

Department of Psychosocial Science, University of Bergen



**Ruth Velsvik**

*MS, Psychology*

Project team member, Anti-Doping Norway



**Britha Røkenes**

*Lawyer*

Director of Testing, Investigations and Legal, Anti-Doping Norway



**Per M. Thorsby**

*Chief physician, MD PhD*

Endocrine Laboratory, Oslo University Hospital

Head of Medical Committee, Anti-Doping Norway



A hand is shown gripping a silver dumbbell. The background is a solid blue color with a subtle gradient. The hand is positioned on the right side of the frame, with fingers wrapped around the handle of the dumbbell. The dumbbell has a textured grip and a smooth, reflective metal head.

**01**

**WHAT IS DOPING?**

## 1.1 Definitions

Among the general public, doping is often understood as taking drugs to obtain a performance-enhancing effect. Many people also associate doping with anabolic androgenic steroids.

In the context of sport, the definition of doping has been extended. It is WADA (the World Anti-Doping Association) that decides which substances and methods are excluded from use in sport. Prohibited substances and methods are listed on WADA's annual List of Prohibited Substances and Methods. For more information on doping in organised sport and the prohibited list, see [www.antidoping.no](http://www.antidoping.no).

The most commonly used doping agents are muscle-building products (e.g. anabolic androgenic steroids), growth factors (e.g. growth hormone) and stimulants (e.g. ephedrine and methylhexanamine). Additionally, it is not uncommon for doping users to take various hormone-modulating substances in an attempt

On 1 July 2013, it became forbidden to use doping agents in Norway. Since the group discussed in this handbook does not take these products as a medical treatment, we choose to use the term abuse rather than use with respect to doping agents.

to reduce the possible adverse effects of doping.

In this handbook, we aim to provide an overview of the most common doping agents and methods and the adverse effects that may arise from their abuse. In this context, it is important to mention that the incidence of adverse effects from doping agents will vary from person to person, which is known as interindividual variation. This may be due to genetic disposition, usage patterns (frequency and duration of use), dosage, age, the degree of purity of the doping agents, underlying disease/sensitivity, and more. Those who abuse doping agents will thus appear as a heterogeneous group and will need individual adaptation and facilitation upon first contact with the health service. This will also be an essential part of further communication with each individual, in order to ensure good, effective preventive work in this area.

Table 1. Classification of common doping agents

Doping agents	Substance group*	Desired effect	Substances
Anabolic androgenic steroids	S1.	Muscle growth, reduced body fat	Testosterone, nandrolone, trenbolone, stanozolol
Growth factors	S2.	Muscle growth (often in combination with AAS)	Somatropin, IGF-1, insulin
Stimulants	S6.	Reduced fatigue, increased energy, increased endurance	Ephedrine, sibutramine, methylheksanamine
Hormone-modulating substances	S4.	Counteract adverse effects of AAS use	Arimidex, nolvadex, clomid, HCG

\* Substance group according to WADA's prohibited list

## 1.2 Areas of use

The first reports of athletes using anabolic androgenic steroids (AAS) to increase muscle strength came in 1954. The use of AAS in sport has been banned since the mid-1970s, and AAS are now the substance group most commonly detected in sport doping. Over the last few decades, testosterone and other AAS have been increasingly abused in training circles outside of sport. In many sports, increased muscle mass and strength are the ultimate goal, and this is closely linked to a performance culture. In addition, fat reduction, reduced fatigue and faster recovery are potentially important doping effects for enhanced sports performance.

In unorganised training environments outside of sport, e.g. fitness/bodybuilding and exercise-based strength training in fitness centres, there are other reasons for using these drugs, primarily strong body fixation and a desire for a slimmer, more

muscular body. It is also known that the use of various doping agents is linked to criminal behaviour and aggression/violence, as they can give a feeling of invincibility and overconfidence in risky situations in connection with illegal activities. It is well known that, in some criminal circles, doping agents are used strategically to lower the threshold for committing crimes.

The dosages are often very high - far beyond therapeutic substitution dosages (replacement dosages). Such use among healthy young people is medically unjustified. Moreover, there are socioeconomic consequences and costs, including the public health impact of the potential adverse effects.

### 1.3 User groups and motivation

It is a challenge to describe dopers outside of sport. From the 1970s to 1990s, one might categorise them as a kind of subculture found in small gyms around the big cities, and they were eye-catching with their abundant musculature.

Today, some 30–40 years later, there have been drastic subcultural and physiological changes with regard to anabolic steroid abuse. Doping is no longer reserved for male bodybuilders, but exists among both sexes, in all age groups and social classes, and most do not visually stand out from the crowd, as they did in the past. There is reason to believe that the major segment of dopers is in their late-teens and twenties, but doping also occurs in other age groups – both younger and older.

It is hard to put a finger on the factors that have been decisive for this development. It may seem that social media and increased bodily focus have had an impact on people's inclination to employ different means in pursuit of the "ideal" body. It has now become commonplace to expose one's body via social media. This has probably affected the existing body-image pressure, and the need to feel attractive is greater than ever. The desire to achieve the ideal body quickly is also an aspect that probably factors into the inclination to use various means toward that end.

Body ideals were also central to the use of AAS 30 years ago, but there has been a clear change in the perception of the ideal body in the meantime. From as big and muscular as possible, the ideal has now shifted to a well-trained body, without very large muscles, but with low fat percentage and

clear muscle definition. It is also important to show that you have control over your own body and prioritise health.

This applies not only to young men, who comprised a majority of users in the 1970s, but also to young women. Young women have gone from having to be as slim as possible, on the verge of the sickliness, to looking well-trained. They do not want too much muscle, but it should be defined, and they should have a relatively low fat percentage.

### 1.4 Adverse effects in general

Any substance that can give a therapeutic/desired effect can also produce adverse effects. In this context, the desired effects of doping abuse are summarised in Table 1. The adverse effects are detailed in Chapter 6.0.

One might assume that a more potent substance produces adverse effects at lower doses than a less potent substance, but this assumption is quite uncertain. Potency is usually evaluated based on the main pharmacological effect of the drug, and thus does not need to reflect the risk of inducing adverse effects.

One can say that an adverse effect is a harmful and unintentional effect of a medicine/product that occurs at doses normally used for humans or animals with a view to preventive treatment, and diagnosis and treatment of diseases, or to restore, correct or modify physiological functions.

Typically, adverse effects are divided into six main types:

1. **Predictable adverse effects based on the substance's pharmacological effect**
2. **Unpredictable adverse effects, often various types of hypersensitivity reactions**
3. **Adverse effects due to prolonged use, often related to dose and duration, and may come on gradually and increase with sustained use**
4. **Late adverse effects - e.g. carcinogenesis and heart disease, whose effects can develop long after use of the medicine/substance has stopped**
5. **Adverse effects following discontinuation of use (cessation), especially if it was discontinued abruptly**
6. **Unexpected therapy failure - usually dose-related and most often caused by interactions of multiple drugs**

The different doping agents can generally be expected to provoke adverse effects in all of the above-mentioned categories. In workout contexts, doping is often done at high doses, which significantly increases the risk of adverse effects within several of the categories above.

## 1.5 Production and distribution of doping agents

Before 2000, it was common for doping agents to enter the country as finished products, ready for use, coming from Russia and countries in North Africa, Asia and Eastern Europe. Couriers were sent to these countries and smuggled the drugs through customs. The situation today is significantly different. There are still couriers who smuggle performance-enhancing drugs, but a lot is now going through the post as well. However, the greatest change has perhaps been that the production of AAS and other doping agents to a significant extent takes place here in Norway. Several large doping networks have been exposed in recent years.

The backers of these networks have in all cases been quite ordinary people: men in their 20s to 40s with jobs, families and an interest in working out. The networks have been set up with backers who control the finances and assign tasks. Certain individuals have been assigned the task of producing certain doping agents for distribution. Buying and selling took place on websites where you could create a user account and then access some of the content. After establishing a certain level of trust with users, or having someone vouch for you, you receive access to more of the content, including discussion forums and product and price lists. With the help of encrypted e-mail addresses, you could then order products and communicate with the sellers.

Many AAS are known as “designer drugs”. Such substances are made in underground laboratories where quality and testing requirements are minimal or absent. At such laboratories, substances are not tested to assess safety and efficacy for the users,

as is the case with medicines approved by public health authorities for use in medical treatments.

Several of these substances are also put into dietary supplements, where there may be undeclared ingredients. Among other things, so-called prohormones have been detected, which are converted into active AAS/testosterone in the body, exposing users to unforeseen health risks.

It is virtually impossible for users to distinguish between pharmaceutical products and those produced under uncontrolled conditions in an underground laboratory. By using such products, the user has no control whatsoever of the contents of what they are consuming.

There can be anything from an absence of a substance to excessively low/high concentrations and other ingredients that can be very harmful to health. This must therefore be regarded as an “extreme sport” where users put their health on the line.

WORLD  
ANTI-DOPING

CODE

02

LEGISLATION

## 2.1 Doping-related penal provisions

Section 234 of the Norwegian language version of the General Civil Penal Code of Norway makes it illegal to manufacture, import, implement, store, transmit or transfer substances considered to be doping agents. The definition of what is considered a doping agent at any given time is contained in the Norwegian Regulations on What Shall Be Considered as Doping Agents. Gross doping violations are regulated by section 235 of the Norwegian language version of the General Civil Penal Code of Norway. After 1 July 2013, it is prohibited to acquire, possess or use doping agents as described in the said regulations without legal permission. Provisions on the acquisition, use and possession of doping agents are authorised by section 24(a) of the Norwegian Medicines Act.

## 2.2 Idrettens bestemmelser knyttet til doping

The doping provisions of the General Civil Penal Code of Norway and the Norwegian Medicines Act should not be confused with the WADA regulations governing athletes worldwide. WADA's regulations are more extensive than the provisions of the General Civil Penal Code of Norway as to what is considered doping. WADA's regulations are known as the World Anti-Doping Code (WADC).

All members of sports teams in Norway are subject to the statutes set out by the Norwegian Olympic and Paralympic Committee and Confederation of Sports (NIF's statutes). Chapter 12 of NIF's statutes regulates the doping provisions for sport in Norway. NIF's statutes are in accordance with the WADC.





**03**

**PREVALANCE**

In the 1960s, top athletes and bodybuilders were the main users of doping to build muscle and improve strength and athletic performance. However, in the last four decades, the phenomenon has spread to the general public, and millions of healthy people who do not necessarily engage in sport are now using doping agents. AAS are the most used substance category both within sport and elsewhere.

Several motives are given for doping, including increased self-confidence and self-esteem, sexual attractiveness, increased aggression and better on-the-job performance for security personnel. From a public health perspective, the increasing illegal use of AAS is worrying, given the negative physical, psychological and social consequences associated with their use.

This chapter provides a brief summary of study results of lifetime prevalence, i.e. the extent of AAS usage in Norway, the Nordic Region and globally.

### 3.1 Lifetime prevalence in Norway

Several studies have been conducted on the prevalence of AAS use in Norway. The European School Survey Project on Alcohol and Other Drugs (ESPAD) reports overall lifetime estimates of around 1% for students in upper secondary school. We find similar numbers in recent surveys by a nationally representative selection of youth.

National surveys generally report lifetime estimates of 1-2%, where one expects more widespread use among men than among women in line with the common belief that AAS use is mainly a phenomenon among males. Nonetheless, experienced availability and exposure seem high, as 6-9% admit that they have been offered AAS, which corresponds to various news reports about seizures of AAS and other doping agents. The proportion of men who admitted to being offered AAS is higher ( $\approx 10-15\%$ ) than the proportion of women ( $\approx 2\%$ ).

### 3.2 Lifetime prevalence in the Nordic Region and globally

Documentation of the prevalence of AAS use in the Nordic countries can be obtained from a meta-analysis of 32 studies (with a total of 233,475 people), presenting lifetime estimates in the Nordic countries. Information about the global spread of AAS usage is also based on a similar meta-analysis of 187 studies presenting lifetime estimates from around the world. Tables 1 and 2 provide an overview of significant findings from these studies.

Table 1 Lifetime AAS prevalence in the Nordic Region (Sagoe et al. (2015) NAD 31, 7-20)

	<b>Studies</b>	<b>Prevalence (%)</b>
Total	48	2,1
Men	41	2,9
Women	32	0,2
Country		
Sweden	20	4,4
Norway	13	2,4
Finland	7	0,8
Iceland	5	0,7
Denmark	3	0,5
Sample		
Drug abusers	2	59,2
Athletes	5	32,3
Prison inmates and detainees	3	26,2
Fitness enthusiasts	1	2,1
People who do not engage in sport	3	1,2
Upper secondary school	34	0,9

Table 2 Global AAS lifetime prevalence (Sagoe et al. (2014) *Ann Epidemiol* 24, 383-98)

	Studies	Prevalence (%)
Total	271	3,3
Men	112	6,4
Women	83	1,6
Regional		
Middle East	7	21,7
South America	5	4,8
Europe	81	3,8
North America	126	3,0
Oceania	38	2,6
Africa	11	2,4
Asia	1	0,2
Sample		
Fitness enthusiasts	18	18,4
Athletes	48	13,4
Prison inmates and detainees	6	12,4
Drug abusers	20	8,0
Upper secondary school	109	2,3
People who do not engage in sport	70	1,0

Table 1 shows the lifetime prevalence in the entire Nordic Region at 2.1%. As expected, AAS use is also more prevalent among men (2.9%) than among women (0.2%). It is estimated that 3.3% of the world's population has used AAS at least once and, as expected, usage is more prevalent among men (6.4%) than among women (1.6%). The estimates above show millions of past and current users having present or future exposure to the potentially harmful risks and adverse effects associated with AAS use.

In the Nordic Region, the results showed that AAS use is most prevalent in Sweden, followed by Norway, Finland, Iceland and Denmark. Globally, the Middle East is the region with the most prevalent AAS use, followed by South America, Europe, North America, Oceania, Africa and Asia. An important indication is that the use of AAS is not limited to Western countries but is rather a global phenomenon, requiring international measures.

In the Nordic Region, AAS use is most prevalent among drug abusers, followed by athletes, prison inmates, fitness enthusiasts, people who do not participate in sport and secondary school students. Globally, we found AAS use to be most prevalent among fitness enthusiasts, followed by athletes, inmates and detainees, drug abusers, secondary school students, and people who do not participate in sport. In line with the previous indication, this points to a change in the population segment using AAS - from the top athletes and bodybuilders of the 1960s to the general population in recent decades - and the many motives for AAS use.

### 3.3 Prevalence estimates of AAS use

Documentation of AAS use prevalence is an important indicator in the effort to manage AAS use and its potentially harmful impact on past and current users, their families and society. Such documentation, however, has its limitations. First of all, you cannot rule out inaccurate estimates due to responses that are false positives or false negatives due to poorly formulated questions. It is clear that some respondents claim to have used “steroids” when they have actually used a supplement or drug that does not contain AAS. On the other hand, surveys show that young people believe it is worse to admit the use of doping than narcotics and consequently the actual numbers for doping are in fact higher than those found in the surveys designed to identify the extent of AAS use prevalence.

Moreover, memory also plays a role in lifetime estimates, as opposed to current estimates / estimates of “current use”, as they encompass a longer usage period that may vary from days to years. Contrary to

estimates of “current use”, lifetime estimates cannot be confirmed by objective measurements such as blood and urine tests. It is also worth noting that new methods regarding masking agents and technology can compromise objective measurements. With the explosive growth in the use of dietary supplements, it has also become more difficult to determine whether a person has used doping consciously or done so unconsciously through contaminated supplements.

### 3.4 Conclusion

One must conclude that the increasing use of AAS is a public health problem that requires a joint effort by academics, police, healthcare personnel and public agencies.





04

**THE ENDOCRINE  
SYSTEM**

Many of the most common muscle-building and fat-reducing drugs are hormones or have similar properties, including AAS, growth hormone, insulin and ephedrine. Hormones are small, water-soluble and fat-soluble substances that send signals to a variety of the body's cells via the bloodstream. The endocrine system slightly resembles the nervous system, because the level of a hormone is often controlled by the central nervous system (CNS). The amount of a hormone in the bloodstream is controlled by feedback to the CNS on whether the level is "correct" for the body.

Hormones are produced by various glands throughout the body. The "thermostat" for many of them is the pituitary gland in the CNS. Along with other parts of the CNS, it affects whether more or less of a hormone is produced in the hormone-producing glands. In the bloodstream, hormones will often be attached to binding proteins, which are mostly made in the liver, and their levels are also affected by hormones. Hormones usually work by binding to specific receptors on target cells. The receptor may sit on a cell's surface or in its nucleus. Binding to the last receptor will influence the reading of our genetic material and the formation of a variety of proteins (fig.1).

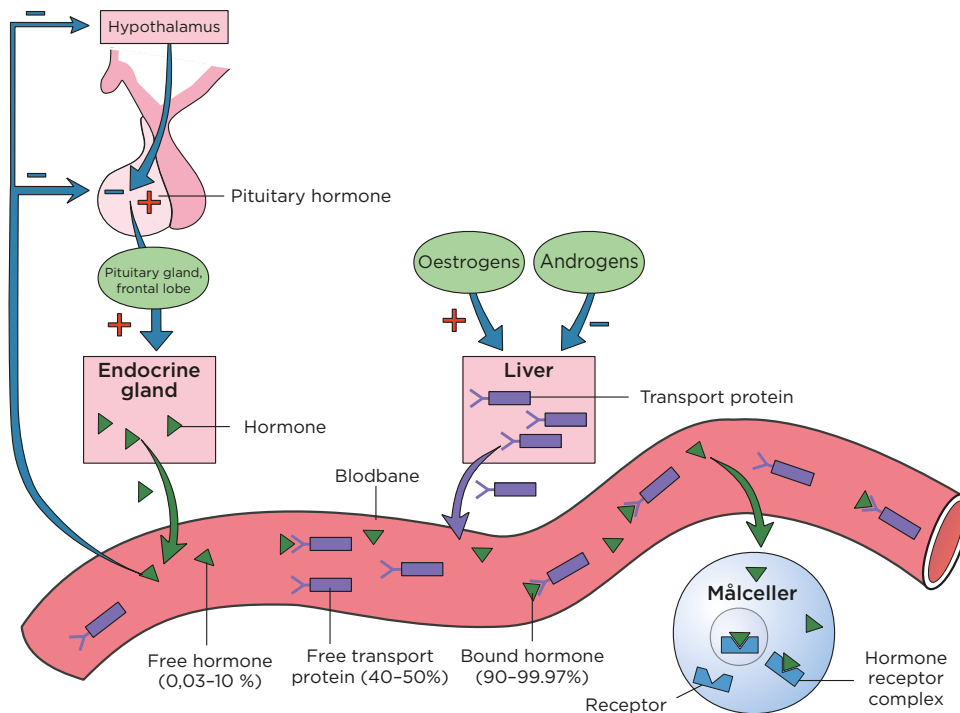


Figure 1. Transport of hormones. Medical illustration from Kari C. Toverud CMI (certified medical illustrator). From "Menneskets fysiologi" by Sand, Sjaastad and Haug, Gyldendal Akademisk.



The typical effects of hormones include influencing energy metabolism in cells (insulin, thyroxine, cortisol, adrenaline), growth and development (sex hormones, growth hormone, insulin) and reproduction (sex hormones).

The main hormone-producing glands related to the use of doping agents are:

- *The pituitary gland* – the regulator of a variety of hormones and production of growth hormone;
- Insulin producing cells in the *pancreas*;
- *The adrenal glands* – where adrenaline, cortisol and weak sex hormones are made;
- *Testicles and ovaries* - where testosterone and oestrogen are produced, respectively.

## 4.1 The pituitary gland

The pituitary, a small gland about the size of a pea, lies at the base of the brain, midway between the eyes. It produces a variety of hormones and pre-hormones, i.e. hormones that regulate several of the body's other hormone-producing glands. Practically all the disruptions of the body's hormone balance will be detected by the central nervous system, and the pituitary gland will then regulate its level of specific pre-hormones that directly affect the relevant gland that produces a given hormone. This means that if you take artificially produced hormones, such as testosterone, the testosterone pre-hormone from the pituitary gland will be cut off, thus reducing the body's own production of this

hormone. This can be observed with a simple blood test, because we can measure both the pre-hormone and the current hormone in the blood at the same time.

It is easy to detect whether a person has taken a hormone supplement (through doping, for example) or not, as the body's response to the presence of an administered hormone is to put its own production of this hormone on "the back burner". When a person stops taking hormone supplements, it may take a long time before the body restarts its own production of that hormone. In some people, it may never get started again. Hormones that are administered in "doping doses" can therefore lead to significant disturbances of the pituitary gland's pre-hormones and hormones.

Growth hormone is one of those made in the pituitary gland. Growth hormone is released into the bloodstream in quick pulses, especially at night. As the name indicates, this hormone is important for growth and development. Much of the growth hormone effect occurs through increased production of the protein IGF-1, which is made in the liver. A variety of cells have IGF-1 receptors, and the signal for growth and development goes from the growth hormone to the cells via IGF-1.

People who take growth hormone supplements will typically have increased levels of IGF-1. They can also experience unwanted cell growth in inappropriate tissues.

## 4.2 The pancreas

The pancreas is in the abdomen, right by the stomach, and its main function is to produce digestive enzymes for the gastrointestinal tract so that we can break down and utilise the nutrients from dietary proteins. Inside the pancreas, there are small “islands” of insulin-producing cells.

They are connected to the bloodstream and are sensitive to blood glucose levels.

If the blood sugar is high, they excrete insulin. Actually, they are excreting some insulin all the time, but mostly in connection with meals. The main task of insulin is to regulate blood sugar so that it is kept at a stable level.

Insulin binds to receptors on a variety of cells, but mainly in the liver, muscle and fat tissue, where the binding of insulin means that sugars can be absorbed in the cells and stored for later use, or converted into fat (fat cells).

In the liver and muscles, long sugar chains are formed that can be used later if blood sugar levels drop or the muscle needs immediate nutrition.

The brain only “eats” sugar, so to speak, so good regulation of blood sugar is very important to the body. Insulin also has a weak building-up (anabolic) effect, and is therefore used as doping. The risk of too much insulin is low blood sugar, which is potentially life-threatening.

## 4.3 Adrenal glands

The adrenal glands sit on top of both kidneys, but are still a completely separate organ. They consist of two parts. The adrenal cortex, the outer part of the adrenal gland, is where hormones of the steroid category are made, all of which are fatty substances with the same molecular skeleton.

These substances have somewhat overlapping effects. The outermost part is where substances related to the body’s salt balance and blood pressure regulation are formed.

The middle part is where the stress hormone cortisol is formed, which also has anti-inflammatory effects that are used in medicinal treatment. To some extent, these substances also affect energy turnover in cells.

The middle of the cortex is where the androgens, or weak male sex hormones, are made, which have somewhat anabolic effects in both men and women. Entirely different substances are produced in the marrow, such as the acute stress hormone adrenaline, which affects the heart rate and causes increased heart beat when we get scared.

It helps us to fight or escape when we face a threat (the “fight or flight” hormone), so it was very important for survival when we lived in the wilderness. Adrenaline causes a quick increase in metabolism, especially in muscle cells.

The hormone is used in doping, where it can lead to severe cardiac arrhythmia.

## 4.4 Ovaries and testicles

The ovaries, which are connected to the fallopian tubes and uterus, are the organ that matures the egg cells from the first menstrual period until menopause. They also produce the hormone oestrogen, which is important for the development of the female genitals and the female sexual characteristics (breasts, female fat distribution, etc.).

Before puberty and after menopause there are very low levels of oestrogen in the blood. Oestrogen is a steroid and also has anabolic effects, especially on bone tissue. Together with oestrogen, progesterone is also formed in the ovaries.

These hormones control the maturation of the egg cells through the menstrual cycle, in close association with the pituitary gland. Use of gender

hormones in women interferes with this interaction. The best example is birth control pills, which contain both oestrogen and progesterone. When these are artificially administered to the body, the interaction between the pituitary gland and the ovaries ceases and the eggs will not mature or be released to the uterus. That is why it works as a contraceptive. When a woman stops taking the pills, her body's own hormone production will return.

The testicles, found in the scrotum, are the organ that makes testosterone, in the Leydig cells, closely monitored by the pituitary gland. Testosterone also affects sperm production. Testosterone contributes to the formation of the male genitals and sexual characteristics (muscle mass, increased hair growth, deep voice, etc.).

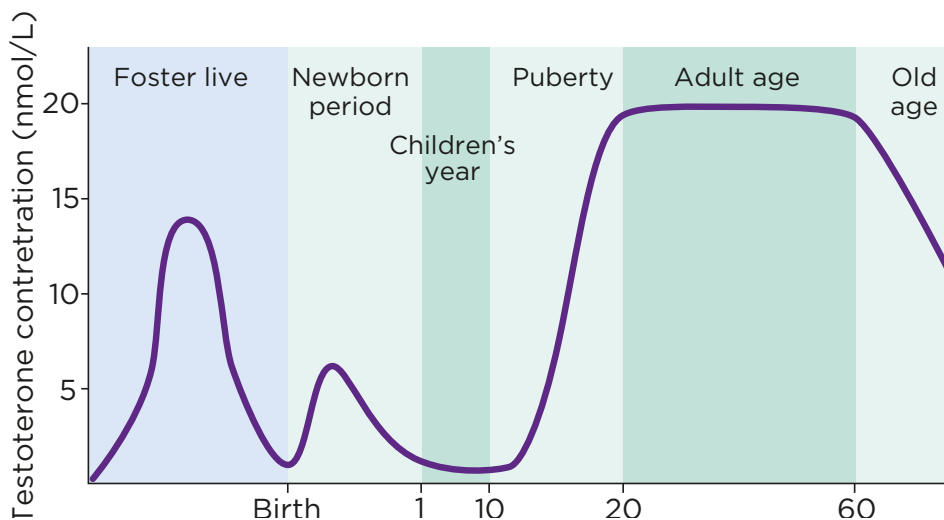


Figure 2. Medical illustration from Kari C. Toverud CMI (certified medical illustrator). From "Menneskets fysiologi" by Sand, Sjaastad and Haug, Gyldendal Akademisk.

Testosterone is also a steroid and has both androgenic (affecting male sexual characteristics) and anabolic effects. It is probably the testosterone that contributes to men having 10–30% greater muscle mass than women.

The hormone “builds” muscles. Male foetuses have very high levels of testosterone in their bloodstream. We believe this may be significant to male behaviour. New-born males also have very high levels of the hormone. Subsequently, the levels decline and return to high levels during puberty (fig. 2). Men maintain relatively high testosterone production throughout life, although available testosterone drops somewhat with age.

Use of AAS - substances similar to testosterone - may interfere with all these processes. Such use leads to more muscle mass, but because testosterone is converted to oestrogen in the body, one can develop “man breasts”.

The testicles’ own production of testosterone is suppressed by the administered substances. Sperm production will also decrease and contribute to testicular atrophy, as the balance between the pituitary gland and testicles is disturbed, leading to eventual infertility. Testosterone can also have adverse effects on the cardiovascular system, as it leads to changes in fatty substances in the blood (cholesterol).

We believe that the use of large doses of AAS leads to behavioural changes. First, one will probably experience increased energy and libido, which will later be replaced by aggression and jealousy, possibly leading to anxiety and depression. People who use AAS generally seek healthcare when they develop psychiatric complaints.

Women who use AAS experience many of the same effects as men, but they may also develop a deep voice, which is generally irreversible. Some may have clitoral hypertrophy, which can be very painful and may require surgical intervention.

The body’s endocrine system comprises close interaction between the CNS, the pituitary gland and the hormone-producing glands. Consequently, hormones administered in “doping doses” can cause a number of disturbances in this fine balance, with a number of unfortunately adverse effects, some of which may be difficult to get rid of after stopping doping.



05

**DOPING AGENTS**

## 5.1 Anabolic androgenic steroids (AAS)

### Background

In men, testosterone is mainly produced in the gonads (testicles), at a rate of about 7 mg (2.5–11 mg) per day. Testosterone is the primary natural male sex hormone and is responsible for the androgenic (male) and anabolic (tissue-building) effects seen during male puberty/adolescence and adulthood.

Testosterone is a significant anabolic hormone and regulates many different functions in the body besides gender characteristics and sexual functioning, including the amount of muscle protein (increases it), bone turnover (stimulating/anabolic effect on bone tissue formation), cognitive function (psychological functioning/thought processes), erythropoiesis (stimulates bone marrow formation by increasing erythropoietin (EPO) production in the kidneys) and blood lipids.

Testosterone exerts its effects by binding to androgen receptors (binding sites for testosterone within the cells) and the differences between the biological effects depend on which target organ/tissue is affected. Androgen receptors are found in almost all bodily tissues; AAS thus affect many different cells and tissues.

It is suggested that the anabolic effect of AAS may be due to its ability to bind and block glucocorticoid receptors (binding sites for cortisol, “the body’s cortisone”), which helps to inhibit the effect of glucocorticoids, which are known to have a tissue-degrading (catabolic) effect.

### Medicinal treatment

Insofar as these products are intended for medical use, they are used in the medicinal treatment of hypogonadism (testosterone deficiency in men), in chronic tissue-degrading diseases such as chronic obstructive pulmonary disease (COPD) and serious infectious diseases. AAS can also be used in the treatment of severe burns, extensive surgery and radiation therapy, as well as cachexia (weight loss, weakness, very poor general health) brought on by cancer, to reverse a catabolic process in very ill patients, in hopes of initiating an anabolic phase.

AAS are also used to treat osteoporosis, severe liver and kidney disorders, wound healing and anaemia. AAS abuse in training is significantly different from medical use, especially with regard to dosage.

### Chemical modification of testosterone

AAS are chemical modifications of the most important male sex hormone, testosterone, designed to increase its anabolic effect while attempting to reduce the unwanted androgenic effects and to improve the molecule’s pharmacological properties. There is a tight link between the molecular structure and effects of these substances, and only small chemical modifications in the molecular skeleton can cause significant differences in effect.

However, it appears that the anabolic and androgenic effects are so closely linked in these molecules that they cannot be completely separated, regardless of chemical modification. That is the basis for these substances to be termed anabolic andro-

genic steroids, or AAS. This means that all AAS, in addition to being potent anabolic drugs, will also affect the sexual function of both women and men, including giving women a more male look, which is known as virilisation.

Modification is also done to enable different modes of administration (oral vs injection), and to produce substances with different effect profiles (anabolic activity vs androgenic activity, degree of fluid retention, etc.) so that users can choose substances with the effect profile they prefer.

## Dosages, administration and usage patterns

Detailed knowledge about doses, modes of administration and usage patterns of the various AAS is somewhat inadequate. Many of the substances are not used as medicines, but for doping purposes only, and there is little documented literature on the topic to be found. Moreover, AAS abuse falls in a dosage range that is said to be 10–100 times higher than a therapeutic dose, and sometimes even significantly higher than this.

AAS can be taken both orally and through injections, but they are so fat-soluble that they can also be absorbed directly through the skin using patches and gels, ointments or creams. This applies mainly to testosterone, which is found in different variants, with good absorption through the skin. In terms of doping, oral tablets and injections predominate, which also impacts the adverse effects profile and potential.

Oral intake means that the majority of a given AAS dose passes through the liver when absorbed by the

intestines. The absorption of these substances from the intestine is good, exposing the liver to significant toxicity because all absorbed substances in high concentrations must pass through the liver every time the substance is taken. In addition, the substances are designed to avoid liver metabolism (17 alpha alkylation), and this also contributes to longer half-life, increased liver exposure and increased risk of liver damage. Oral AAS are therefore considered to be significantly more hepatotoxic than injected AAS.

AAS injection can cause local reactions of both allergic and infectious nature at the injection site. Other toxic skin reactions can also occur, and may cause significant local inflammatory conditions. Infections can be caused by both bacteria and fungi, and can cause significant abscesses. If users share syringes, the risk of transmitting infectious diseases will increase significantly. Parenteral administration (injections) of AAS is somewhat “easier” on the liver than oral administration, but when using high doses over time, this will be eliminated and the adverse effects will be essentially the same.

In doping circles, the term “cycle”, is used to define the use of doping agents in particular doses and intervals within a given time period. One tailors a cycle with doping agents based on the user’s starting point and doping goal. It is known that bodybuilders follow a pattern called “stacking” based on taking several oral (tablets/capsules) and parenteral (injected) AAS products simultaneously in a 4–12-week cycle. Cycle lengths may also vary beyond this, with stoppage of drug intake between them. Simultaneous use of multiple substances in cycles with breaks is done in an effort to minimise adverse effects and to prevent development of tol-

erance, that is, to prevent the need for higher doses of substances to achieve the same effect. The dose during a cycle is initially low, but gradually increases and then gradually descends towards the end of the cycle to avoid ailments due to drug stoppage; this is known as pyramiding. AAS dosage varies from 250-1000 mg/week, but according to various websites, doses up to 2000 mg/day are not uncommon among bodybuilders; these are extremely high doses with significant risk of health consequences. Some people eventually abuse these drugs on a nearly continuous basis without clear breaks.

Hormone-modulating substances are used at the end of and after an AAS cycle. This is known as post-cycle therapy. These substances are described in more detail in section 5.4

## AAS adverse effects in general

AAS adverse effects can be categorised as 1) physical, 2) psychological and 3) social. The last category encompasses the societal consequences of AAS abuse in the form of substance abuse, aggression, violence, murder and other crime. The incidence and severity of AAS adverse effects depend on the:

- Dose
- Type of drug
- Combination of drugs taken during the cycle
- Frequency and duration of use
- Expected effects of the substances (especially the psychological)
- Age and gender of the user
- Individual response variations (genetic predisposition/sensitivity)

In case of medical substitution treatment with approximately physiological doses (e.g. of testosterone), adverse effects are rare and usually mild. In abuse (doping in a training context), the doses will usually be in the range of 10-100 times higher than therapeutic doses, and the risk of adverse effects will be very high. This is seen in the arsenal of supplementary treatments these abusers deploy against various adverse effects along the way in their abuse trajectory.

## Adverse physical effects from the use of AAS

**Acne (spots)** is common. This can be a big problem, as the blemishes become large, deep and often blood-filled, and the condition can be significantly resistant to medical treatment. This is a partially reversible condition, but may leave significant scarring.

**Salt and fluid retention** are frequent and represent a significant portion of the weight gain, especially in the initial phase. Use of diuretics is also seen in users of doping agents.

**Gender characteristics and sexual function:** Androgens have several direct and indirect effects / adverse effects on the genitals and the sexual and reproductive functions.

Direct androgenic stimulation using AAS may cause prostate hypertrophy (growth and enlargement of the prostate) and accelerated growth of prostate cancer. High doses may also cause persistent erection (priapism), which can be dangerous and cause irreversible penile damage.



Use of high, supraphysiological doses of androgens/AAS inhibits the release of LH and FSH from the pituitary gland, leading to reduced sperm production and reduced fertility or infertility. Reduced testicular volume and a complete lack of sperm are seen at very high doses. Although reduced sperm production may last for several months after discontinuation, fertility will normalise in most people. However, documentation of this is lacking for very high doses over long periods of time, and thus it is uncertain whether the effects in such cases are fully reversible.

Libido may be increased or decreased depending on whether you are on or off the cycle, increasing during the cycle and possibly decreasing between cycles. This is why erectile dysfunction drugs like Viagra and Cialis are used. These adverse effects will usually normalise as hormone levels return to normal after discontinuation, but it may take considerable time.

**Paradoxically**, the administration of androgen may also lead to feminisation, especially manifested as breast development in men (gynecomastia), due to the aromatising and increased conversion of androgens/AAS into oestrogens, which stimulate growth of the male's mammary glands. This is an irreversible change, and the breast tissue must be removed surgically.

**Alopecia (hair loss)** is an adverse effect that can be seen in both sexes at high AAS dosages. It mainly causes male-pattern baldness (also in women), with pronounced hairline recession and bald-spot creation, which are irreversible changes.

**Liver toxicity** (risk of liver damage) is seen rela-

tively frequently, from slight changes in liver enzymes to greater bile duct and jaundice affection, usually seen with the use of 17 $\alpha$ -substituted compounds that can be taken orally. Injections can also cause liver damage, although they may be slightly less harmful. High doses over time, irrespective of the mode of administration, will significantly increase the risk of liver damage. Development of liver cancer after prolonged use of such steroids has been described, but occurs rarely. Development of blood cysts in the liver and liver failure after prolonged abuse have also been described. Most of the liver damage is reversible, and reverts after the end of treatment.

**Heart and circulatory system:** Androgens have several effects that can have unfortunate long-term effects on the cardiovascular system. Even within the normal concentration range, testosterone provides a slight reduction of "good" cholesterol (HDL) and increase in "dangerous" cholesterol (LDL). This can lead to arteriosclerosis, with a risk of blood clots that can lead to increased risk of heart attack and stroke. These changes are more pronounced in high-dose androgen/AAS use. Increased platelet aggregation is also described, and can contribute to an increased risk of blood clots. In addition, there is mention of elevated blood pressure, but this is usually a completely reversible condition.

An increased incidence of myocardial infarction has been reported in younger men who abuse AAS, and this is an area being closely monitored. One should always consider AAS abuse in cases of young, muscular individuals hospitalised for chest pain. Similarly, there are descriptions of an effect on cardiac size, with altered structure and thickening of the left ventricle wall.

This can lead to arrhythmia, heart failure, heart attack and sudden death. In addition, the use of AAS predisposes to vasospasms (contraction of blood vessels in the arteries of the heart), with the risk of angina pectoris and myocardial infarction. AAS has also been shown to have a direct toxic effect on the heart (connective tissue formation, oedema and tissue failure in the heart muscle), which can also contribute to significant risk of cardiovascular events. There is evidence that a growing number of premature heart attacks are due to AAS abuse. Some of these cardiac effects are irreversible and will most likely increase the mortality of cardiovascular events over time.

**Blood:** polycythaemia (too many red blood cells) because androgens/AAS stimulate blood formation in the bone marrow through stimulation of erythropoietin production in the kidneys. This is especially pronounced in females, who have lower haemoglobin than men in the first place, so that the relative effect is greater.

Polycythaemia can also be seen in substitution therapy in assumed physiological doses. These are basically reversible adverse effects, but if they should lead to cardiovascular events (blood clots), there may be irreversible damage.

**Muscles and skeleton: increased muscle strength increases the risk of tear injuries in general in the musculoskeletal system.** This is because the muscles grow faster and become

stronger than the corresponding adjustments in the connective tissues. This allows the muscles to tear at the tendon attachment points, so that you can feel tear in the muscle itself or in the connective tissue. Such injuries can leave problems over time, but will most often heal. Muscle cramping is also an adverse effect. This is most likely due to the muscle growing so quickly that the growth of new blood vessels cannot match the pace.

Therefore, there may be a relative lack of blood vessels in the musculature (fewer vessels per area), and this may cause metabolic problems in the muscles due to somewhat reduced blood flow and accumulation of mineral waste, which may lead to bouts of cramping.

Chronic fibromyalgia-like pain can be seen in young individuals abusing these substances in large doses. This can present treatment-related challenges. This is a somewhat unclear picture, and it is difficult to explain this in a satisfactory way.

Recent studies link the long-term use of AAS to deficient brain volume and cortex thickness

## Specific adverse physical effects in women

Virilisation, i.e. the development of a masculine appearance, is the dominant visible adverse effect, especially under long-term administration of these drugs. The symptoms include increased body hair, hair loss and a deeper voice. All of these are essentially irreversible.

In addition, increased libido, clitoral enlargement (irreversible) and masculine-like changes in musculature (more masculine body shape) are also found. Menstrual disorders, including loss of menstruation, are common and may cause infertility. In pregnancy, there is a danger of foetal virilisation. Some of these are reversible changes, but there are women who have major difficulty becoming pregnant after prolonged AAS use, so it cannot be excluded that in some cases the harm is partially irreversible.

## Adverse effects specific to children and adolescents

AAS abuse among minors can have especially unfortunate consequences. In addition to many of the above-mentioned adverse effects, the intake of androgens/AAS, after first leading to early onset of puberty and a temporary growth spurt, will stall further longitudinal growth due to closing of the growth zones in the bones. These are irreversible changes, and the longitudinal growth is lost forever. Moreover, it cannot be ruled out that long-term adverse effects can be especially severe when these substances are given to children and adolescents. At present, there is not a great deal of expertise in this area, and only a close fol-

low-up of individuals who have used such substances at a young age could provide answers as to the medical consequences - both physical and psychological - over time.

## Adverse psychological effects of AAS use

Mental changes are relatively common and a wide range of adverse psychological effects have been observed. Irritability, aggression and violent behaviour, depression and various psychotic reactions have been observed, usually at high doses. In addition, sleep disorders have been reported in a relatively large proportion of abusers. These adverse effects show high individual variability and are not very predictable, but can be quite severe. A number of case reports have linked the use of high-dose AAS/androgens to violent crime. Upon discontinuation of AAS use, depression can manifest as one watches the body that has been built up over a long period fade away, with a feeling that one's self-image is vanishing. Serious depression may in some cases lead to suicide or attempted suicide.

## Relationship between AAS and violence

The extent to which there is a connection between the use of AAS and aggressive and violent behaviour is under discussion in professional circles. A report from the Norwegian Knowledge Centre for the Health Services concluded that there is insufficient scientific evidence to state that there is a causal link between the use of AAS and aggression and violence. However, it was stated that the existence of such a link cannot be excluded and that such a connection may exist, especially at high

doses and/or when sensitive individuals combine substances.

It is no wonder that such data is inadequate, as it is difficult to obtain scientific data in such a field. Much of the available knowledge has come from interviews with former dopers, animal experiments and case reports on major crime, violence and killing, where use of these substances has been proven. The total accumulated knowledge in this field suggests that there is a connection between AAS use and aggressive/violent behaviour, but so far, it has not been possible to have it documented in quality-assured scientific articles due to ethical problems in designing and implementing such studies. The existing data will thus not provide a certain basis for drawing reliable conclusions.

Disrupting factors in assessing the relationship between AAS use and aggressiveness and violence are the person's predisposition (personality type/traits,

psychological state) and the concurrent use of other substances, e.g. narcotics, alcohol and stimulants, which could affect reactions to AAS to a relatively great extent. There have been several scientific approaches to this field, and several of them suggest that there is a causal link between AAS use and aggressive/violent behaviour. However, in some of them, when corrections for concurrent use of other substances and psychological illness or deviant personality are made, the results are frequently not statistically significant in terms of the influence of AAS. Users themselves suggest that they become more aggressive when using AAS, so it is highly likely that it induces or lowers the threshold for aggressive or violent behaviour, but so far, this has not been fully proven scientifically.

It is important to emphasise that despite there being no causal connection between AAS use and violence, the overall knowledge in this field indicates a probable connection.

Observed adverse reactions using AAS can be summarised as follows: mania/hypomania (agitation, feelings of euphoria), depression (from mild to very severe), anxiety/panic attack, uneasiness, sleep disorders, diminished impulse control, psychosis development (may be severe, schizophrenia), megarexia (opposite of anorexia), lack of empathy (i.e. feeling for others), jealousy, paranoid delusions (delusions of persecution), confusion, mood swings, aggressiveness and violence. These symptoms are most likely affected by underlying mental illness or predisposition to it and concurrent use of other drugs, but there are strong indications that the symptoms above are closely related to AAS use.

The reversibility of various mental disorders is unclear, and in certain cases (psychosis, deep depression), it may be considered to be not entirely reversible.

Suicide has also been seen after AAS use, most often associated with the development of depression.

## Dependency

There are no indications in the literature of dependency development under AAS in medical doses. However, it is suggested that high AAS doses over time can lead to dependency. It has also been suggested that chronic AAS use may cause a form of opioid dependence, since animal studies have shown biochemical changes in the brain's reward system that can contribute to dependency. AAS do not give the same intensely pleasurable sensations that a number of narcotics do, but they have been shown to provide a form of well-being that may trigger use. The literature states that the potential for AAS addiction is low and that the withdrawal symptoms are mild.

However, development of discomfort and depression has been shown to be associated with discon-

tinuation of these drugs, and that may be a reason why abusers return to AAS use, simply to get rid of such conditions. This may feel like being drawn to more AAS, thus creating an addictive feeling, but does not reflect the terms of the traditional pharmacological definition of drug addiction. Nonetheless, some studies claim that AAS addiction is relatively common, whereas others interpret this to apply to only a small group of abusers. All in all, the potential for addiction from these substances appears to be somewhat unclear and controversial.

Those who use AAS are basically "intoxicated" by their own body, and this is the great driving force in this abuse. When the body shrinks after discontinuing AAS, the ensuing discomfort and depression may lead to continued abuse, which may be considered a form of addiction.

## 5.2 GROWTH FACTORS

### Growth hormone

Growth hormone is produced in the pituitary gland and is important for normal growth and development. It is an anabolic hormone, that is, it increases protein synthesis and affects most bodily tissues. Growth hormone is produced in the cells of the pituitary gland. The regulation of growth hormone secretion occurs through the pituitary and the hypothalamus, the part of the brain located just above it. In the hypothalamus, both stimulating and inhibiting factors are produced, and the relationship between them determines the quantity of growth hormone released. Negative feedback in the pituitary and hypothalamus on growth hormone and IGF-1 (insulin-like growth factor 1) is an important

regulatory mechanism, i.e. growth hormone inhibits its own secretion from the pituitary gland. Growth hormone regulation is thus complex, and the secretion increases with different types of mental and physical stress and physical activity. Growth hormone is thus considered a stress hormone. The amino acids arginine and leucine also stimulate the secretion of growth hormone and the effect is thought to come via the hypothalamus. Growth hormone secretion is greatest at the end of the teens, and gradually decreases with age.

Growth hormone stimulates the formation and release of IGF-1 (see below), mainly from the liver, making the growth factor a primary conveyor of many growth hormone effects, including longitudinal growth.

Although the body's own growth hormone is important for normal muscle growth and development, it has not been clearly documented that administering external growth hormone affects muscle growth. However, it cannot be ruled out that large doses of growth hormone used for doping purposes, combined with training, can help to increase muscle mass somewhat, but such doses can also lead to potentially serious and permanent adverse effects. Growth hormone is often used in combination with other AAS drugs, particularly testosterone.

The most common adverse effects of large doses of growth hormone used as a doping agent are:

- Increased body hair growth (hirsutism) and sweating and oily skin
- Sleep disorders, fatigue, headache, gynaecomastia, muscle weakness
- Higher blood pressure (hypertension)
- Heart growth and heart failure
- Growth of internal organs and fluid accumulation in the tissues (oedema formation)
- Bone growth, especially in the head and facial skeleton, even after puberty (abnormal skeletal development). Altered bite, growth of the nose, ears, hands and feet over time
- Muscle and joint pain and reduced nerve function with numbness (paraesthesia), such as carpal tunnel syndrome
- Increased blood glucose levels and increased risk of developing type 2 diabetes ("adult onset diabetes")
- Prolonged abuse can increase the risk of cancer, especially in the gastrointestinal tract

Acromegaly is a condition of overproduction of growth hormone, and is mainly due to a tumour in the pituitary gland. Acromegaly comprises an accumulation of the symptoms that occur from using a large quantity of growth hormone over time. Several of the mentioned adverse effects are included in this clinical picture. The changes occur slowly and are often unnoticed until they have been long underway. Acromegaly gives users a distinctive look.

## IGF-1

IGF-1 is an anabolic hormone (growth factor) mainly produced in the liver; its production and release is stimulated by growth hormone, and conveys the latter's growth-stimulating effect. IGF-1 is also called somatomedin C, and has a structure reminiscent of insulin. IGF-1 affects many different body cell types, contributing to the growth and development of many different tissues. IGF-1 can also be produced from cartilage cells in the bones, and then acts locally in the bones as a stimulant

of longitudinal growth. The IGF-1 concentration is highest in puberty, and the stimulation of longitudinal bone growth is thus greatest in this period of life. The IGF-1 level declines with age. Not only does IGF-1 have a growth-stimulating and anabolic effect, but it also plays a role in growth hormone regulation and hinders the secretion of growth hormone in the event of negative feedback on cells in both the hypothalamus and the pituitary gland. In contrast, the effect of IGF-1 in adults is uncertain, and results in training studies are inconclusive.

Example of a performance-enhancing drug: Increlex (mecasermin) - not registered in Norway (for treating short stature attributable to deficiency of growth hormone and IGF-1).

Mode of administration: solution for injection

The most common adverse effects from using IGF-1 as a doping agent are:

- Headache
- Blurred vision
- Nausea
- Enlarged tonsils
- Low blood sugar (hypoglycaemia) - see "insulin"
- Musculoskeletal pain (pain in the knees and hips)
- In addition, many of the same side effects as listed for growth hormone.

## Insulin

Insulin is an anabolic hormone created in the beta cells of the islets of Langerhans in the pancreas. The key purpose of this hormone is to participate in regulating the blood sugar level. Insulin boosts the assimilation of sugar into the body's cells, which causes blood sugar levels to drop. In the context of medicine, insulin is used to treat patients suffering from type 1 diabetes (insulin deficiency diabetes), but can also be used to treat chronically ill type 2 diabetics.

Insulin has a muscle-building (anabolic) effect, and is therefore often used for doping. Inexpert use carries a major risk of life-threatening adverse effects. The most dangerous of these is low blood sugar (hypoglycaemia), which can lead to coma and death. Insulin is often used in combination with growth hormone because GH raises the blood sugar slight-

ly (diabetogenic effect), providing a broader safety margin for the use of insulin. However, insulin is an extremely potent and dangerous hormone in the context of doping. Certain drugs work quickly, while others are designed to produce a longer-lasting effect. Available insulin products include both pure human insulin and a number of different insulin analogues, which are modified forms of human insulin. Mode of administration: powder and solution for injection

Mode of administration: solution for injection

### 5.3 Stimulants

The abuse of stimulants is the oldest known form of doping. This group of doping agents also includes many substances that are classed as narcotics. A common trait of these agents is that they stimulate the central nervous system. This psychostimulant effect reduces symptoms of fatigue and lack of energy, and can improve physical capacity and endurance.

Many dopers combine the abuse of AAS with a variety of stimulants. The intention here is to raise physical limits so as to achieve a better return on the physical training. Even though stimulants have been used for doping for centuries, no documentation exists proving that stimulants in and of themselves improve the metabolism - although it has been demonstrated that the increased endurance and amount of training that athletes can achieve through the use of stimulants does have a positive effect on metabolism. These agents thus indirectly boost the metabolism. A number of serious adverse effects - both acute and chronic - are linked to the use of substances of this kind.

The most common adverse effects from using insulin as a doping agent:

- Fatigue/faintness/weakness
- Cold sweat, cold and pale skin, nervousness, agitation, anxiety, confusion, feelings of hunger, tremors
- Unconsciousness and/or cramps
- Transitory or permanent brain damage/death

### Amphetamines

Amphetamines are chemically produced psychostimulants and are classed as narcotics. Amphetamines were previously used to treat a range of psychiatric complaints, and have also been used as slimming agents.

It is also widely known that in extreme cases, amphetamines were given to fighter pilots to help them stay awake and to concentrate during long missions. For the same reason, amphetamines and cocaine have been used for many years as doping agents in sports.

Mode of administration: tablets, capsules, powder and solution for injection



The most common adverse effects of amphetamines:

- Headache, agitation, restlessness, nervousness and sleep disruption
- Mood swings, aggression, violent behaviour
- Increased self-esteem and reduced critical sense
- Reduction in appetite / weight loss
- Palpitations, raised blood pressure and cardiac arrhythmia - incidences of myocardial infarction and stroke have also been recorded
- During hard physical exercise: higher risk of increased body temperature (“heat stroke”), muscle damage, kidney failure, coma and death.
- Drug addiction
- Adverse psychological effects (confusion, anxiety, externalising behaviour, paranoia, hallucinations, psychoses, etc.)

## Ephedrine

Ephedrine is a mild psychostimulant that also raises the pulse and blood pressure, and deadens feelings of hunger and sleepiness. There are a number of pharmaceuticals that contain ephedrine and which are used in the treatment of various medical conditions - especially in connection with infections of the airways and low blood pressure.

Ephedrine is used for doping on account of its psychostimulant effect, and it is also employed as a slimming agent because it diminishes appetite and helps metabolise fat. Its performance-enhancing effect is poorly documented, and scientific opinion is divided regarding its effect in the area of dieting. It is illegal to import ephedrine into Norway, although it can be purchased over the counter in other countries. Ephedrine abuse results in the de-

velopment of tolerance, such that people who take it gradually require higher and higher doses over time to achieve the same effect. This is true of several of the substances mentioned here.

Mode of administration: solution for injection, tablets, mixture, as a powder in dietary supplements (often added without declaration, so it is important that athletes be extremely careful when taking different forms of dietary supplement).

The most common adverse effects of ephedrine:

Ephedrine produces many of the same adverse effects as amphetamines, although in milder form. Taking high doses will make the effects on the heart and major vessels (cardiac arrhythmia and high blood pressure, for example) and the psychological effects more apparent; it will also increase the risk of serious adverse effects. Physical weakness in the form of a hidden heart disease increases the risk of serious adverse effects and death.

- Agitation, restlessness, sleep issues
- Tremors, headache
- Dizziness, nausea/vomiting
- High blood pressure (hypertension)
- Raised pulse/palpitations
- Urination issues (especially when the prostate is enlarged), impotence
- Confusion, anxiety and possible psychosis
- Deaths have been documented

## 5.4 Hormone-modulating agents

Most people who abuse AAS take other medicines in parallel with them so as to minimise/prevent unwanted adverse effects from AAS. These may include oestrogen blockers such as exemestane, clomiphene and tamoxifen, which are typically used to prevent breast development in men, potency stimulators such as tadalafil and sildenafil, which are used to treat impotence, and benzodiazepines, which produce a calming, anti-anxiety and sleep-inducing effect. An appreciable number of other substances are commonly taken in combination with AAS, not only to reduce adverse effects and prevent the detection of various substances in doping tests, but also to increase the anabolic effect.

Aromasin (exemestane) is a steroid and an irreversible aromatase inhibitor, which hinders the conversion of androgens (male sex hormones) into oestrogens by deactivating the enzyme aromatase in peripheral tissue. This prevents the conversion of administered AAS into oestrogen substances, and is used to hinder the development of oestrogen-dependent adverse effects such as gynecomastia. It has been demonstrated that this substance can have a negative effect on liver function and cause a rise in liver enzymes, as well as raised bilirubin levels in the blood. This is stated as a less common adverse effect, but must be considered to be a major potential risk in the event of simultaneous use of liver-toxic AAS.

Clomiphene (Clomid, Pergotime) is also an oestrogen blocker, but with a different effect mechanism. It appears that this substance works by blocking oestrogen receptors in the hypothalamus,

which controls the brain's hormone production, and in the pituitary gland. This reduces the obstructing effect of oestrogen on the pituitary gland (less negative feedback), while the release of the gonadotropins LH (Luteinizing Hormone) and FSH (Follicle-Stimulating Hormone) from the pituitary gland increases and stimulates ovulation in women. In the context of doping, this medicine is primarily used to prevent the oestrogen effects on the pituitary gland as a result of aromatisation. It has been reported that in rare cases, the substance may have an effect on the liver, but again, it is important to consider that use in conjunction with liver-toxic AAS may lower the threshold, resulting in a predisposition to liver damage. In addition, rare cases of thrombosis have been mentioned. Since AAS can also produce a higher risk of thrombosis - which is a well-known adverse effect - it is important not to discount the possibility of this risk rising in individuals when these drugs are taken together.

Tamoxifen (Nolvadex and Tamoxifen) is a conventional oestrogen receptor blocker. The substance binds directly to oestrogen receptors, thus preventing oestrogen from binding to these and producing the usual effects. The substance is a non-steroid pharmaceutical with a complex spectrum of anti-oestrogen and oestrogen-like effects in different types of tissue. In the treatment of breast cancer, the primary effect of tamoxifen is to prevent oestrogen from binding to oestrogen receptors. The substance may affect the liver, so use in combination with liver-toxic AAS must be considered less than beneficial. It has also been stated that this substance may cause thrombosis and even pulmonary embolism, which is not an uncommon ad-

verse effect. It can be highly risky to take this substance in combination with relatively high doses of AAS which, in and of themselves, can contribute to a higher risk of thrombosis.

It is difficult to assess the risk of adverse effects from taking hormone-modulating agents in combination with AAS, and no studies have been completed of this combination. However, if both groups of substances can cause an elevated risk of liver damage and thrombosis, it must be assumed that taking both together would raise the risk even higher.

Cialis and Viagra are taken to counteract the negative effect AAS has on men to achieve erection. Rare adverse effects of Cialis and Viagra are effects on the heart and major vessels, which can lead to acute myocardial infarction, unstable angina pectoris, cardiac arrhythmia and stroke. These are serious adverse effects and most common in patients with pre-existing cardiovascular risk factors. Use of large doses of AAS over time is highly likely to make users susceptible to such adverse effects, and such a combination must therefore be considered extremely risky.

## 5.5 Polypharmacy

It is not known precisely how dopers use these medicines, i.e. whether they are used in recommended therapeutic doses or in higher quantities. AAS abusers are generally healthy young people who “make themselves ill” by using AAS that cause everything from mild to more serious adverse effects. Hormone-modulating agents and other pharmaceuticals are used to treat the adverse effects of doping as if they were an actual “illness”, and

it must be assumed that the substances taken do have an effect in such treatment. In this context, the benefits of taking these medicines will be to reduce the potential for adverse effects from the substance abuse, but the drawback will naturally be that these medicines have adverse effects of their own that may actually be potentially serious for the individual, and which in combination with the AAS may further increase the health-related consequences to the users. The total pharmaceutical load on the organism becomes significantly higher when such “auxiliary treatment” is used, and may result in additional damage to health.

The conclusion is that taking large numbers of pharmaceuticals simultaneously to treat different medical conditions is extremely unwise, especially given that some of the adverse effects attributable to these medicines may amplify the adverse effects of taking AAS. An additional consideration in this context is that these people are not monitored closely or followed up in a medically correct manner, in the same way as actual patients are, and this will naturally increase the health-damaging effects of both AAS abuse and the use of supplementary medication to combat the original adverse effects.

## 5.6 Use of doping in combination with narcotic substances

It has been claimed that the use of AAS may serve as the gateway to other forms of substance abuse, but the development may also run in the opposite direction, in that there is some disagreement as to the “chicken and egg” aspect of this issue.

It is stated in literature that AAS abusers are commonly associated with appreciable polypharmacy

(i.e. the simultaneous use of multiple substances/medicines) and dependency, but knowledge of the entire pattern of abuse remains unclear and insufficient. The significance of AAS in the development of combined abuse with alcohol and drugs (and other substances) thus requires additional research.

It is known that AAS are often combined with a variety of drugs and alcohol, including stimulants such as ephedrine, ecstasy, cocaine and amphetamines, as well as with depressants such as benzodiazepines, opiates/opioids (morphine, heroin, dextropropoxyphene), GHB (gamma-hydroxybutyrate), etc. It seems to be the case that certain AAS are combined with specific narcotics, but that the abuse of AAS is often combined broadly with a variety of intoxicants with a view, for example, to repressing irritating adverse effects such as sleep problems and pain after heavy training. A Swedish interview survey from 2009 studied 32 AAS abusers; it revealed that polypharmacy is common among AAS users, and that around half drank alcohol in appreciable and even harmful volumes. With regard to other drugs (narcotic substances), the survey revealed use of cannabis (81%), amphetamines (78%), ecstasy (56%), GHB (47%), cocaine (41%), LSD (28%) and heroin (25%). Cannabis was used to improve sleep and relaxation, heroin to ease the pain of tough training, and amphetamines to improve endurance and to “burn off fat”. The survey thus revealed serious supplementary abuse, and many articles highlight similar trends.

This illustrates the importance of focusing on the substance abuse as a whole when in contact with - and following up on - this group, such that it is possible to step in and provide the best possible

health-related assistance, and attempt to help abusers to break the cycle of abuse. It has been claimed that healthcare personnel have too little knowledge and skill in this field, and that this results in abusers often lacking confidence in doctors and other healthcare professionals; this, in turn, leads them to provide incomplete information when they are in contact with the healthcare system. This is not good for the interaction between abuser and the healthcare system in treatment situations.


Combined abuse makes it extremely difficult to identify the effects of AAS in relation to the effects of other substances and drugs. There can be no doubt whatsoever that combined abuse of this kind will increase the frequency and seriousness of the adverse effects, and may also amplify some effects of AAS themselves - violent behaviour, for example. Such combined abuse may therefore lead to significantly aggressive and violent behaviour over and above what is considered “usual” from the use of AAS alone, and may also cause appreciable dependency and drug issues.

It is not easy to predict the long-term consequences on health of such combined abuse, but it is likely that such abuse will result in serious health-related complications. There are major concerns linked to abuse of this kind; for example, concerning the adverse effects of the individual substances - especially taking into account that many of them are taken in large volumes - how the different substances interact (affect one another) when taken simultaneously, and the development of dependency on and abuse of alcohol. This is a complex and complicated situation that is likely to present major challenges to the healthcare system in the immediate future.

## 5.7 Summary, adverse effects

1. All anabolic-androgenic steroids (AAS) have the potential to cause the same adverse effects. The differences between these substances become blurred when it comes to adverse effects, because they are used in doses that produce the same effect, and because these doses are additionally supraphysiological.
2. The potential of AAS to produce adverse effects is significant, and long-term use in large, supraphysiological doses poses a strong risk of damage to health. However, the substances are only slightly acutely toxic, and overdoses are only treated symptomatically. AAS can produce a variety of adverse psychological effects (from mild to serious), and some of these are completely unpredictable.
3. As of today, AAS are not yet classified as dependency-forming substances, as the scientific basis for such classification is still lacking.
4. The accumulated knowledge concerning the use of AAS and aggression/violence does suggest a connection. However, such a connection has not yet been unequivocally proven through unambiguous scientific studies.
5. It is known that AAS are often combined with a wide variety of drugs and alcohol, and this has been demonstrated in numerous studies. The use of AAS thus largely predicated the additional (ab)use of other drugs and alcohol. There is great concern for the health-related consequences of such combined abuse and the challenges this is sure to pose to the healthcare system in the long term.
6. Use of other pharmaceuticals - known as "auxiliary treatment" - in conjunction with AAS translates into a high level of polypharmacy. This is unfortunate, especially given that some of the adverse effects identified for these medications may amplify the adverse effects seen from the use of AAS. An additional consideration in this context is that abusers are not monitored closely or followed up in a medically correct manner, in the same way as actual patients are, and this will surely increase the health-damaging effects of both AAS abuse and the use of supplementary medication to combat the original adverse effects.



A blue-tinted silhouette of a muscular man's upper body, showing the neck, shoulders, and arms. The lighting highlights the contours of the muscles.

06

**THE USERS' UNIVERSE**

## 6.1 Anabolic-androgenic steroids (AAS): User knowledge and drug-specific adverse effects

Before the advent of the internet, information about AAS was most readily available through physical meetings with sellers and users in the environment. The knowledge communicated was often based on the user's own experiences with regard to the effects and adverse effects of the drugs. Some claimed that their experiences were in line with what others might expect, while others stated that individual differences might arise, and that users would have to find out for themselves.

Today, a great deal of information is available on the internet. There is everything from websites set up to sell performance-enhancing drugs, to sites for users to share their experience in discussion forums and blogs. This often takes the form of sharing information about different doping agents and experience linked to their use. Users and potential users exploit these channels to seek confirmation or to legitimise their own views and opinions about doping. A potential user can often build up appreciable "expertise" in doping before embarking on their first "cycle". Information from these sources may appear objective and is often presented in a scientific manner, with references to research and backed by figures and tables. Unfortunately, there is a clear tendency to exaggerate the positive aspects of doping, while downplaying the negative consequences. As such, users of these sources are provided with an oversimplified and incorrect image of doping and the problems associated with it.

Based on the "expertise" acquired, users assess a number of factors as they initiate a doping cycle.

These typically include:

- Personal starting point and objective for the doping
- Evaluation of different types of AAS and which combination of drugs will provide the desired result and minimise the risk of adverse effects
- The tracking time of the various substances - where this is relevant with regard to upcoming tests

In doping circles, performance-enhancing drugs are often presented with a primary and secondary mode of operation, as well as scores for their anabolic and fat-metabolising properties, referred to respectively as the "*bulking score*" and "*cutting score*". Users can access this information on the internet, in doping literature and from other users.

Since it is claimed that the different drugs have different effect profiles, the final step is to put together a combination of products based on the assessment of the individual's starting point and objective for the doping. Users can do this themselves, based on their own "expertise", or they can purchase complete "cycles" from a dealer.

Users often discuss adverse effects with each other. Some consider adverse effects to be "part of the game", i.e. something you simply have to accept will happen at some point. Others think they can be controlled by taking precautions such as using hormone-modulating substances and through what is known as "Post Cycle Therapy". Documented adverse effects of doping and such auxiliary



treatment are described in Chapter 6.0. Despite the fact that some adverse effects can be linked to specific drugs, users may be largely unaware of the scope and degree of seriousness of these adverse effects before they start doping. This is partly because adverse effects are linked to genetic dispositions and vulnerability. The use of doping will therefore be a major game of chance, with the user's health at stake.

A familiar issue often discussed in doping circles is whether a given drug results in "aromatisation", i.e. whether testosterone is converted into oestrogen, which at the next level may have an effect on cells with oestrogen receptors. One consequence of aromatisation may be gynecomastia, a condition whereby men develop mammary glands. Not all such drugs are converted into oestrogen, and it is reasonable to assume that users would therefore avoid aromatising substances, but it seems that aromatising drugs are nevertheless in widespread use on account of their positive muscle-building effects. On the basis of experience from users, it seems that the susceptibility to developing gynecomastia varies. In some users, it occurs relatively quickly and at even low doses of a single drug with aromatisation potential. It is worth noting that gynecomastia is considered to be one of the most common adverse effects of AAS.

Some websites devoted to doping list a number of products with what is referred to as the "A/A ratio". This serves as a description of the ratio between the anabolic and androgenic effects of a given product. As mentioned previously, these two effects are closely inter-related, and are impossible to separate completely. In doping literature, however, it is claimed that some products are more or less ana-

bolic and androgenic than others. It is relevant to note that few of these substances have been subjected to testing in the same way as ordinary pharmaceuticals. The claims regarding effect are therefore largely based on user experience. In doping circles, testosterone is the reference substance, and has a ratio of 100:100. The steroid Trenbolone has a ratio of 500:500, i.e. five times more potent than testosterone on both parameters. The ratio for Winstrol is 320:30, which means it is more anabolic but less androgenic than testosterone. This provides an indication of what users can expect in terms of effect - and adverse androgenic effects.

Once all the research and planning has been completed, the user/seller draws up a plan of the various products that are to be taken together ("*stacking*") during a given period ("*cycle*"). One possible approach is to have a "base", which is a drug taken throughout the cycle. During the first half to two-thirds of the cycle, it is common to use a product with a high anabolic score. Drugs of this kind can cause users to look "fluffy", because the substances bind water, giving users an "inflated" appearance. Users therefore often choose to stop using such products in the latter stages of the cycle, replacing them with one or more drugs with a high fat-burning score. They do this to achieve more clearly defined musculature. During this period, some users also choose to use diuretics - products designed to expel water from the body. Here, too, users often consider taking hormone-modulating agents and pharmaceuticals to counteract the side effects of AAS, especially reduced own production of testosterone and the aromatisation of testosterone into oestrogen. The use of such medicines produces its own set of adverse effects, exposing the user to a greater risk of suffering serious adverse effects on

health. For additional information see Chapter 5.0. Of the many different types of AAS, slightly fewer than 20 are in common usage today. Please note that the information is intended to replicate the

factors users tend to take into account, and the information stated in various user sources. This information is less scientifically documented and confirmed.

<b>Name of drug</b>	<b>Active ingredient</b>	<b>Aromatase</b>	<b>c17-aa</b>	<b>A/A ratio</b>
Anadrol	Oxymetholone	No	Yes	320:45
Anavar	Oxandrolone	No	Yes	322-630:24
Deca Durabolin	Nandrolone-Decanoate	Yes	No	125:37
Dianabol	Methandrostelone	Yes	Yes	90-210:40-60
Equipoise	Boldenone-Undecylenate	Yes	No	100:50
Halotestin	Fluoxymesteron	No	Yes	1900:850
Masteron	Drostanolone-Propionate	No	No	65:25
Parabolan	Trenbolone-Hhbc	No	No	500:500
Primobolan	Methenolone-Enanthate	No	No	88:44-57
Sustanon	Testosteron "stack"	Yes	No	100:100
Testosterone Cy-pionate	Testosterone-cypionate	Yes	No	100:100
Testosterone Enanthate	Testosterone-Enanthate	Yes	No	100:100
Testosterone Propionate	Testosterone-Propionate	Yes	No	100:100
Trenbolone Enanthate	Trenbolone-Enanthate	No*	No	500:500
Turinabol	4cdmt	No	Yes	100:0
Winstrol	Stanozolol	No	Yes	320:30

## 6.2 Growth hormone

In doping circles, it is said that growth hormones have many of the same muscle-building properties as AAS. Growth hormones are said to help burn off fat, and it is claimed that they help injuries and wounds to heal more quickly. There are contradictory opinions regarding the effect of growth hormones when used without other drugs, but when they are taken together with AAS they are rumoured to have a significant anabolic effect. It is relevant to note that scientific literature contains little evidence to support the claim that taking growth hormones has a positive effect on muscle mass in healthy people - even when combined with physical exercise. Growth hormones are also used as an “anti-ageing product”.

Some dealers in doping circles claim that the biggest group of customers for these products comprises women in their forties who use them for this very purpose. The doses they take will be much lower than those used in connection with body-building. However, there is little evidence to suggest that growth hormones will have such an effect on

otherwise healthy people. Medical experts actually caution against the use of growth hormones to combat the effects of ageing and other natural changes in the body. Growth hormones are extremely expensive. It is much more complicated to manufacture growth hormones than AAS. This means that growth hormones cannot be made in “underground laboratories”, but can only be manufactured in pharmaceutical factories for use as approved medicine. Growth hormones are administered by injecting the medicine into the muscles or subcutaneous fat. Because growth hormones are expensive and can be difficult to obtain, a large number of fake medicines are sold on the market.

In doping circles, it is claimed that growth hormones produce no - or only negligible - adverse effects. This is not true. Growth hormones can actually cause a variety of extremely serious adverse effects.

These are discussed in detail in Chapter 5.2.

## 6.3 Stimulants

Taking psychostimulants is the oldest form of doping. The influence of these substances on the central nervous system boosts energy levels and represses feelings of fatigue and hunger. Stimulants are therefore often used as slimming agents, but are also taken before physical exercise to raise energy levels so that the user can train longer and harder. There are numerous examples of stimulants being added to dietary supplements - in “pre-workout” products and “fat-burners”, for example. The drugs

taken most commonly in doping circles are amphetamines, ephedrine, sibutramine and methylhexanamine.

They are used for doping both separately and in combination with all other groups of doping agents. The method of administration is primarily oral, in the form of powder or tablets. The adverse effects of stimulants are discussed in Chapter 5.3.

## 6.4 Hormone-modulating substances

The use of hormone-modulating substances is known as “Post Cycle Therapy” in doping circles. It is claimed that taking such medicines can minimise or even eliminate the known and feared adverse effects of AAS.

However, these substances have their own adverse effects and will naturally increase the total pharmaceutical burden on the user.

It is common to take these drugs towards the end of and/or after a cycle of AAS. Pharmaceuticals known to be taken for this purpose include hCG (Human Chorionic Gonadotropin), Pergotime - Clomifen, Nolvadex - Tamoxifen and Arimidex - Anastrozole.

hCG is used to stimulate the testicles to produce sperm and testosterone again. During an AAS cycle, where own production is repressed or even shut down completely, the testicles will shrink. Therefore, one indication that hCG has started working is that the testicles begin to grow in size. It is commonly referred to by saying that “the factory has started up again”.

Many people believe this to be a sign that the body’s hormone production has restored the natural balance. This is not the case. hCG stimulates the testicles to produce testosterone, but the pituitary gland - which produces LH and FSH - remains shut down. Some users consider this to mean they are ready to start a new AAS cycle. They are thus lured into believing that their bodies are functioning normally again following an AAS cycle. The longer the pituitary gland remains “out of action”, the greater the risk of developing a protracted or permanent state of disrupted hormone production after discontinuing AAS use.



07

**DIETARY  
SUPPLEMENTS**

## 7.1 Dietary supplements used in connection with physical exercise

Dietary supplements are concentrated sources of nutrients or other substances that have a nutritional or physiological effect. Dietary supplements are classified as nutrients. They are intended to supplement the user's usual food intake, and should not be used to replace a varied diet. In Norway, the Norwegian Food Safety Authority is responsible for checking the production and sale of dietary supplements. When used in connection with physical exercise, dietary supplements can be divided into four categories.

### Sports products

Sports products are special products designed for use before, during and after training. Sports products that contain carbohydrates, electrolytes and fluid are used during training to allow training intensity to be maintained when the glycogen stores are depleted, the blood sugar falls and the fluid balance is disturbed. Examples of such products include sports drinks, energy bars and gels.

Other sports products are used immediately after long and/or hard training sessions to promote the body's restitution processes by refilling the depleted glycogen stores and stimulating protein synthesis. Examples include recovery shakes that contain protein and carbohydrates, protein shakes and recovery bars.

### Medical dietary supplements

Medical dietary supplements are used to accommodate daily nutritional needs or to treat deficiencies. They provide a supplementary source of nutri-

ents such as vitamins, minerals and Omega-3 fatty acids.

Some medical dietary supplements contain nutrients in the same volumes as the recommended daily intake laid down in the Norwegian nutritional recommendations. Examples include cod liver oil products that contain 10 µg vitamin D as the recommended daily dose, and multivitamin pills that contain the recommended daily doses of the most important vitamins. These dietary supplements are used as supplements to diets that do not provide sufficient nutritional content on their own for one reason or another. Medical dietary supplements used to treat deficiencies contain higher doses of the substance in question and generally comprise a single vitamin or mineral. One example of this is iron supplement, which contains 100 mg of iron. The daily recommended intake of iron is 9-15 mg for adults.

### Dietary supplements containing ergogenic agents

Dietary supplements containing ergogenic agents have - or are said to have - a performance-enhancing effect on training. They contain nutrients or other components found in food, but in higher amounts than we can ingest from our ordinary food and drink. Examples include high-caffeine energy drinks, caffeine pills and creatine supplements. The performance-enhancing effect may be a short-term, stimulating effect from a substance - as from caffeine. It may also be a longer-lasting effect from a substance that accumulates in the body over time and facilitates the effect of training.

## Natural remedies

Natural remedies are dietary supplements featuring natural ingredients that are not nutrients. These include roots such as ginseng, herbs such as echinacea (purple coneflower), and various algae. Some natural remedies are marketed as having an effect beneficial to health; for example, it may be

claimed that they reinforce the immune defence system and reduce the risk of catching a cold. Other such remedies are said to have a performance-enhancing effect - for instance, that they are invigorating or assist with slimming.

## 7.2 Medical dietary supplements and protein supplements – need and effect

Dietary supplements are in widespread use in training circles, and many athletes apparently believe it is necessary to take such supplements in order to ensure good health and to optimise performance. It is well documented that healthy people do not need an extra supply of vitamins and minerals, even if they train frequently and/or hard. Adults who eat enough to cover their energy needs and, at the same time, eat a varied diet that is heavy on fruit and vegetables, will obtain the nutrients they need from their ordinary diet. Extra intake of nutrients over and above what is needed will not have any effect, because the body will not utilise the ex-

tra input of nutrients if it does not have a higher need of them. Medical dietary supplements will boost the health of people who are suffering from some form of deficiency and who therefore need supplements to restore a healthy nutritional balance. Lack of iron is a relatively common deficiency among adult women; left untreated, iron deficiency will result in diminished endurance during physical exercise, and general ill health. People suffering from iron deficiency should therefore take an iron supplement for several months to replenish their iron deposits and restore a healthy iron balance.

Iron supplements and other medical dietary supplements must only ever be taken in consultation with a doctor or a clinical nutrition physiologist, and only after having completed a nutritional and medical assessment of need. Incorrect use of medical dietary supplements can lead to an overdose of vitamins and minerals, resulting in adverse effects on health and nutritional imbalance.

Dietary supplements containing antioxidants such as vitamin C and some natural remedies are often marketed as having a beneficial effect on health. No such effects have been documented. It is well-known that high doses of single antioxidants can reduce the effect of training - in the contexts of

both endurance and strength training. This means that using a high-dose antioxidant supplement - one gram of vitamin C daily, for instance - is more likely to hinder than to promote health. Some foods with a high content of what are known as “phytochemicals” have proved to benefit health,

but this is not the case for dietary supplements containing antioxidants. Foods that are rich in phytochemicals include all types of plant-based foods such as berries, fruit, vegetables, herbs, nuts and grain.

Norwegian dietary advice recommends eating more plant-based foods because they contribute to good health and help reduce the risk of lifestyle diseases.

Phytochemicals: Chemical compounds found in plants. They are not of any direct nutritional significance, but they can have a positive effect on the body's physiology - as antioxidants, for example.

Protein supplements are the supplements most commonly used in training circles. People who train often and hard - both endurance and strength training - need more protein than people who are normally physically active. It is therefore important that these people eat a diet rich in protein.

That is not to say, however, that they have to take protein supplements. A normal diet provides more than enough protein to cover the increased need, as long as the athlete eats enough to cover the increased energy needs that arise as a result of frequent and/or intensive training.

Foods and drinks rich in protein are better options than protein supplements because food and drink provide many other useful nutrients in addition to proteins, which are the only ingredient in protein supplements.

It is recommended that people who train frequently and hard make sure to cover their need for all nutrients by eating a healthy, balanced diet. Not only will this ensure they ingest all the nutrients their bodies need, but it also helps maintain the appropriate balance between the nutrients. Dietary supplements lack important components that a balanced diet contains, and therefore make a poor alternative to a healthy diet.



## 7.3 Performance-enhancing dietary supplements and natural remedies

Dietary supplements containing ergogenic agents are in widespread use in training circles. There are literally thousands of different dietary supplements on the market that claim to boost performance, but only a few of them are backed by scientific documentation. The only ergogenic substances that have so far been documented to have a significant performance-enhancing effect are creatine, caffeine, bicarbonate, beta-alanine and nitrate in beetroot juice.

Dietary supplements containing these substances may improve performance in individual athletes in individual sports and exercises if used correctly,

and if the athlete responds to the use. Even though dietary supplements containing these substances may have a beneficial effect on performance, there are many reasons why they should not be used. Some athletes may have health-related contra-indications for taking these substances - and the athletes themselves may be unaware of them. Several of the ergogenic substances can produce mild adverse effects that can actually diminish the athlete's overall performance. In addition, if these dietary supplements are used incorrectly and in excessive doses, they may produce serious adverse effects and, in extreme cases, constitute a risk to health.

Caffeine in the form of energy drinks and pills is frequently used in training circles on account of its invigorating and stimulating effect. However, the Norwegian Food Safety Authority warns against excessive ingestion of caffeine for both adults and adolescents. Adults should not take more than 400 mg of caffeine per day. Even though caffeine tolerance varies from one person to the next, taking more than 400 mg daily may cause adverse effects such as palpitations, headache, restlessness, nervousness and muscle tremors. Young people have a lower tolerance of caffeine because their bodyweight is generally lower, so they are recommended to limit their caffeine intake to no more than 2.5 mg of caffeine per kilo of bodyweight per day. Both adults and adolescents risk overdosing on caffeine through consuming energy drinks. People are warned especially to show caution when taking caffeine pills, because taking pills increases the risk of overdosing - with the associated harmful effects on health. People who have problems with cardiac arrhythmia are warned against taking caffeine in connection with physical exercise because the combination of high intensity, high heart rate and high doses of caffeine can be dangerous.

Dietary supplements containing ergogenic agents do not feature on the list of doping substances, but they are in something of a grey zone from the perspective of anti-doping measures. The reason for this is that these substances partially fulfil two of the criteria for the inclusion of a substance on the list of prohibited substances: namely, substances

with the potential to enhance performance, and which may cause a risk to the health of the athlete. For example, caffeine is on the WADA's monitoring list because the WADA is waiting to see whether a pattern emerges of caffeine abuse in sport.

Another argument against the use of performance-enhancing dietary supplements is that they may serve as a gateway to actual doping. The gateway theory suggests that the conscious decision to use doping is a result of the athlete's gradual involvement in performance-enhancing activities - in this case, from experimentation with performance-enhancing dietary supplements. It is suggested that this theory is particularly relevant in the context of young people who become used to taking performance-enhancing dietary supplements from a young age.

The use of dietary supplements containing ergogenic agents is deemed inadvisable on a general basis. It is important to emphasise that the effect of ergogenic agents is minimal in relation to all other factors that affect performance in training. Good performance is built on the foundations of sufficient and correct training, the absence of illness and injury, sufficient rest, good restitution routines and a healthy, varied diet.

Dietary supplements are not subject to the same stringent requirements as pharmaceuticals on documentation of contents, effect, adverse effects and interactions. Substances harmful to health have been found in dietary supplements in many instances, including the stimulants synephrine and yohimbine, which are banned in Norway. Such substances can constitute a risk to health on their own, and they can produce serious adverse effects if they are combined with other dietary supplements or medicines. The Norwegian Food Safety Authority encourages healthcare personnel to report adverse effects of dietary supplements in the same way as they report adverse effects from pharmaceuticals.

Performance-enhancing dietary supplements and natural remedies are those dietary supplements that carry the highest risk of containing substances that are harmful to health and actual doping agents.

## 7.4 The risk of dietary supplements containing doping agents

A number of athletes and fitness enthusiasts in Norway have tested positive for doping as a result of taking dietary supplements. Dietary supplements may contain substances that feature on the list of doping agents in the following ways:

a. The dietary supplement may have been contaminated with a banned substance that does not appear on the list of ingredients

Incidents have been reported of contamination with anabolic androgenic steroids such as testosterone and nandrolone, and with prohormones, which are substances that are chemically and pharmacologically related to anabolic steroids. Contamination with stimulants such as ephedrine and methylhexanamine, and with beta-2 agonists such as higenamine has also been identified in dietary supplements. The concentration of the banned substances is usually low in the event of such contamination - but they will nevertheless be traceable in a doping test. In addition, the substances can give rise to a risk to health even though they only appear in small concentrations.

All categories of dietary supplement can, in principle, be contaminated with banned substances, but the risk is higher in performance-enhancing supplements than in medical dietary supplements and sports products. A recently published study revealed an extremely high incidence of doping agents in dietary supplements from makers whose products had previously been found to contain banned substances. A relatively high incidence of banned substances has also been identified in natural remedies - particularly natural remedies

whose ingredients are sourced from Asia.

Contamination of dietary supplements with banned substances may also be due to the maker insufficiently checking the ingredients added to the supplement in question, or there may be problems with the production process. Nor can we completely rule out the possibility that a doping agent has been added to a dietary supplement to ensure it has a marked effect - and thus to boost sales.

b. A dietary supplement may contain a banned substance that does feature on the list of ingredients

Several positive doping tests in recent years have been traced to the consumption of energy drinks that contain the banned substance methylhexanamine. Methylhexanamine is a class S6 stimulant on the list of prohibited substances, and is banned in competition. In most cases, methylhexanamine has been stated on the list of ingredients on the energy drink. The positive test results are due to the fact that the athlete is unaware that the substance features on the list of prohibited substances, or that the banned substance has been listed under a name other than that stated on the list of prohibited substances.

Methylhexanamine has been found in pre-workout supplements (known as "PWO"), energy drinks and dietary supplements marketed as helping to boost energy and fat burning. In Norway, methylhexanamine is classified as a pharmaceutical, and it is not permitted to sell it as a dietary supplement. Dietary supplements and energy drinks containing methylhexanamine are sold legally in some coun-

tries, however. Methylhexanamine appears under a variety of names in the dietary supplement industry, so it is difficult to compare the lists of ingredients to the list of prohibited substances. Frequently used names other than methylhexanamine include “geranium”, “1.3-dimethylamylamine” and “pentylamine”.

The banned substance higenamine has been found both as a declared ingredient in dietary supplements, and as a contaminant. Higenamine is a beta-2 agonist classed as S3 on the list of prohibited substances, and it is banned in both training and competition.

The substance is used as an ingredient in dietary supplements which are claimed to boost fat burning and to counteract asthma and coughing.

Higenamine occurs naturally in a number of plants and is used as a natural remedy in Asia. The substance is unknown on the Norwegian market, but is sold as a dietary supplement in some countries. In the same way as methylhexanamine, higenamine is sold under a variety of names, the most common of which are “norcoclaurine” and “demethylcoclaurine”.

The use of doping agents in dietary supplements can lead to serious risks to health – as well as to positive doping tests. Several incidences have been reported of death, cardiac arrest, myocardial infarction and cerebral haemorrhaging resulting from the use of dietary supplements containing methylhexanamine. Higenamine stimulates beta-1 receptors in the heart and carries a risk of adverse effects such as fast and irregular cardiac rhythm.

Dietary supplements marketed with the following claims are most likely to contain banned substances, and their use is strongly discouraged:

Invigorating effect

Enhanced fat burning and slimming effect

Stimulation of muscle growth and building effect

Hormone-regulating effect

## 7.5 Certification of dietary supplements

There is never zero risk that a dietary supplement may contain banned substances, but it is possible to reduce the risk of contamination. Producers can quality assure their dietary supplements through international certification systems that involve them checking the ingredients and production process, and analysing the finished dietary supplements for doping agents. Dietary supplements that have been produced in line with such certification systems are generally the least likely to contain banned substances.

Several certification systems are already in operation. The best known are:

Informed Sport (Great Britain) [www.informed-sport.com](http://www.informed-sport.com)

Informed Choice (United States) [www.informed-choice.org](http://www.informed-choice.org)

Cologne List (Germany) [www.koelnerliste.com/en/cologne-list.html](http://www.koelnerliste.com/en/cologne-list.html)


The Netherlands Security System Nutritional Supplements Elite Sports [www.dopingautoriteit.nl/nzvt](http://www.dopingautoriteit.nl/nzvt)

### Approval of dietary supplements

Several producers of dietary supplements claim that an anti-doping organisation or WADA-accredited anti-doping laboratory has approved their dietary supplements; but this is not true. Neither WADA nor Anti-Doping Norway approve dietary supplements.

All use of dietary supplements and possible ingestion of banned substances through dietary supplements is the responsibility of the athlete himself/herself. In the World Anti-Doping Code, this is referred to as “strict liability”, which means “objective responsibility” when an athlete tests positive for doping. This means that the athlete himself/herself is solely liable for any ingestion of banned substances - be it from pharmaceuticals or dietary supplements.





08

**PREVENTION**

If we are to eliminate the issue of doping, it is essential to work with prevention. It is in the encounter with young people who have not yet started to use doping – but may be considering it – that initiatives need to be implemented. But who are these potential users, and what characteristics can help to identify them?

Few studies have been completed of this group, but we do know that some young people start to consider using doping at the age of 14–15. While a great many reasons have been given for turning to doping, dissatisfaction with one’s own body seems to be one of the key factors. A desire for bigger muscles and the capacity to do more training are also mentioned in literature. The body and how it looks are used to establish identity and social affiliation. If you have a well-trained body, this is seen as an indication of success and the ability to cope with training and health, while an overweight body is considered to signal the reverse.

There is also a perception that having a fit, well-trained body will make you more attractive to the opposite sex. Young people often state that the desire to get “beach body ready” is the factor that originally makes them interested in starting to use various performance-enhancing drugs – or the reason why they have already started doping. They “don’t have time” to train themselves up in the short period that remains before the summer months, and so they choose doping as a short-cut to a fit, well-trained body. The key issues here are identity, role models, sexuality and gender as a social construct, and the forces in this system are so strong that it becomes the driving force behind the desire to use unlawful, potentially harmful substances to achieve body ideals.

It would be almost impossible systematically to identify young people at risk of starting to use anabolic steroids or other forms of doping. At an age when they are developing their identity, becoming familiar with the opposite sex, exploring their sexuality and making new friends, young people are in a generally vulnerable phase, which makes them “easy pickings” for inappropriate influences.

When it comes to prevention aimed at this group, it is important to present knowledge in the area that is balanced (i.e. both “positive” and negative aspects of doping), and to present them with a viable alternative. In this context, “a viable alternative” could be a comprehensive training programme that will produce the desired result; it could also involve working with self-confidence and a positive self-image. Generally speaking, openness and accommodating dialogue are a good place to start.

## 8.1 Prevention from a lifetime perspective

A broad understanding of how to work with preventing doping entails focusing on what is generally good for health and development in order to ward off problem issues later in life – and the work must start during the very earliest years. This involves, for example, having a good, secure environment to grow up in, the absence of bullying, and appropriate social integration.

## 8.2 Early and broad input

Primary prevention has to do with preventing problems before they arise, and the objective behind a universal prevention strategy is to reach everyone in a given group of the population (a school year, for instance).



Relevant content in this context is information about doping and its harmful effects from health-related, social, societal and legal perspectives. Taking into account that many people start doping after they turn 18, prevention in the form of providing knowledge should start before this age. Preventative measures can also be applied to prevent problems developing or continuing (secondary prevention).

A selective strategy of this kind could, for example, be targeted towards young people you know to be - or suspect that they may be - at elevated risk of developing and/or continuing a doping habit. Some young people have established doping issues, or face other challenges linked to intoxication or pre-occupation with their body's performance.

In such cases, it is possible to apply indicated measures bordering on treatment.

Prevention can involve universal, selective and indicated measures. Some advice for different groups - parents/guardians, coaches and professional groups - is presented below, with a list of selected players currently active in the field of prevention.

### 8.3 Parents and coaches

It is not beneficial for an individual to feel that he/she is not good enough or performing poorly in sports. Parents/guardians and coaches should therefore place emphasis on encouraging children and adolescents to do the best they can, and to focus on developing their own skills. It is preferable to focus on development rather than on winning, or on comparing performance with others on the same - or the opposing - team. This emphasis com-

bined with the joy of sport for sport's sake helps create a culture of fair play and good morale.

The theory of gateway potential suggests that the more medicines taken, the lower the threshold to experimenting with more and potentially illegal substances. A restrictive and critical approach to the use of supplements and "health food" in the home with a view to improving physical performance and appearance is recommended on the basis of this theory. For the vast majority of people - including those who train hard and often - dietary supplements are quite simply unnecessary. A normal, healthy and varied diet will easily cover ordinary nutritional needs.

Young people are exposed to all kinds of images that contain (hidden) messages about what a body should look like, or what form their physical appearance should take. Such exposure to body ideals risks amplifying self-critical comparison and feelings of insufficiency. Bullying and condescending remarks about the individual's body must be actively countered. Taking a critical approach to images presented in the media while interacting with media together can help to develop resistance against negative influence. Actively expressed opinions "are contagious", so it is a good idea to talk aloud about what you are watching on the screen, and about other sources that may make young people feel dissatisfied with their bodies. Role models who take a critical attitude to body ideals and have a broad-minded view of what a body should look like can help contribute to healthy self-awareness.

As human beings, we have a fundamental desire to be seen and receive recognition, and to enjoy the sense of being part of a community. Some people

view doping as a means to achieving this end. Recognition may therefore be sought through positive feedback on social media (Instagram, Facebook, blogs, etc.). In training circles where doping is both recognised and accepted, this produces a sense of community and confirmation for users. The experienced doper can actually feel it is rewarding to give “a helping hand” to doping novices, and may have a financial interest in making sales. It can therefore be useful to talk to young people about this, and about how the other side of the coin is often not revealed. In doping circles, individuals may be criticised if they “cannot handle” their abuse to the extent that it makes them ill, and the actual health risks – particularly the psychological ones – may be downplayed. In addition to downplaying the health risks in doping circles, there is a risk of developing the view that it is completely healthy to indulge in extremely high levels of training. It is important to be aware that “training ideals” can also be unhealthy, from both physical and psychological perspectives.

Working continuously with social inclusion, nurturing and supporting the social network of the individual – outside unfortunate training circles as well – and finding sources for coping strategies and positive self-awareness are all good approaches to helping individuals in the risk zone. Meeting young people with understanding for the challenges they are facing will also help lay the foundations for a strong alliance and future partnership.

## 8.4 Fitness centres

The use of doping is primarily linked to physical exercise and training, and most dopers work out at a fitness centre. It is therefore essential that fitness

centres take an active stand against doping, communicate clearly with their members and implement initiatives as and where necessary. Personal trainers and instructors at fitness centres have a major influence on the target group, and must think carefully about their position as role models for the members.

## 8.5 Schools

Schools are an excellent arena for carrying out preventative work. The pupils are in a context where they expect to learn, they are in the target group with regard to age, and preventative content can be integrated into the learning objectives of multiple subjects.

## 8.6 Skills development among professional groups

Many professional groups interact with young people as part of their work, or come into contact with doping issues in other ways. It is crucial that these groups possess fundamental knowledge about doping such that the individual members are able to prevent doping, pick up on early signs of abuse, and contribute to ensuring that people who are already doping have access to help in kicking the habit. It is important to identify and terminate substance abuse at an early stage so as to reduce the risk of the (ab)user developing permanent and serious adverse physical and/or psychological effects.

## 8.7 Teaching as a prevention strategy

Providing information about doping and its harmful effect is useful, but the information communicated should be realistic and balanced. We recom-

mend taking an interactive approach, involving pupils and students actively in the learning process. The objective is to reinforce the pupils' ability to spot risk factors and risky situations from their own lives and surroundings, and provide them with the capacity and coping skills to handle such situations on their own. Research indicates that pupils who receive guidance in strength training and diet as an alternative to using AAS, who have the chance to role play saying no to drugs, and who have involved, interested parents are less likely to try doping. Other useful approaches may be to talk about and identify sources of influence that power the desire for self-presentation and performance wishes, and to draw up joint strategies for how to handle such issues constructively.

A teacher-led, interactive, conversation-based approach that allows pupils to explore and challenge their own immediate surroundings is an excellent way to develop shared norms and attitudes. Against the background of the theory of planned behaviour developed by Ajzen (1991), it can be said that intentions behind human action are based on what we believe others think about our behaviour, and that social behaviour is regulated by norms. In this context, it can be useful to discuss what is important for social success: a specific type of appearance or good behaviour. Examples of strategies may also include asking body-fixated young people to analyse messages from sources that contribute to negative body image, and to ask pupils to prepare feedback and then communicate it to these sources, explaining how their message is potentially harmful. Another method could be to ask pupils to help prevent negative body images and doping in other people.

Young people may well benefit from being treated as resources in their own lives. They have the capacity to learn to take a critical approach to harmful messages, and can practise ways of countering risk situations with good behaviour and smart, knowledge-based choices. Young people who are at risk should not exclusively be viewed as problems - i.e. as victims of body shaming. Reinforcing and rewarding indications of coping strategies are therefore essential tools for whoever is leading the attitude-creating teaching.

## 8.8 Systematic prevention process

Effective prevention is built on planned theoretical foundations. In planning and execution, it can be relevant to ask: What, specifically, is to be prevented - which factors have an influence and need to be changed? What is needed to make changes, and how can we do it? How can we know that the initiatives have had an effect, and what should we carry over into future work?

Prevention can be applied at several levels: at the individual/psychological level, at the group/organisation level, and at the cultural and societal level. At the individual level, prevention may take the form of supporting thought processes that generate a healthy self-image, and which result in feelings of coping and competence. At the group level, it may be more a question of perceived social support in making correct decisions, as well as fundamental knowledge about the consequences of doping. At the societal level, prevention can be achieved by adopting and maintaining legislation that punishes the possession and use of doping agents.

The image above illustrates a model for how work to prevent doping may be applied, and where experience gained during the process forms the basis for ongoing work. Below is a list of selected players whom it may be relevant to involve in a working relationship.

Multiple arenas with preventative messages and work, continuous prevention over time, and coordination between players all help to boost prevention work. Good prevention and handling of doping also depends on the individual acquiring knowledge. In this way, the person promoting prevention will become a good, relevant source of information, and can counterbalance “experts” in the form of other doping users, producers and sellers.

## 8.9 The tough conversation – suspicion or use of doping

If you suspect doping, it is a question of daring to invite the person concerned in for “the tough conversation”. Here, you should take as your starting point a) your own observations, and link them to b) known indications and symptoms of doping, c) refer to the fact that you can see similarities with what you know as use of doping, and d) that you are concerned. If the user is on a “cycle”, as it is known, he or she will probably be less motivated to make a change than someone who has just finished a cycle or is between cycles. However, if you have initiated a conversation, it could be easier for the person in question to make contact again once a dialogue about the downsides has been opened – particularly if the user knows that he or she will be well received. Users may attempt to legitimise their use of doping by referring to common myths and acceptance of doping in the circles they frequent.

In this context, it is important to make sure that any information passed on to users in subsequent conversations is balanced and correct, such that it is not dismissed out of hand as “scaremongering”. It is also important to work with the social network surrounding the user, and to prepare conditions for a life involving coping and recognition without doping.

The police may also hold concern conversations with young people they suspect are on the point of starting – or have actually started – doping.



Anti-Doping Norway