Nandrolone – mystery and facts

Nandrolone, or 19-Nortestosterone, is one of the most widely used synthetic anabolic-androgenic steroids by athletes who need power and muscle strength. It is derived from testosterone, the main sex hormone produced in man. A small chemical modification makes nandrolone more anabolic than androgenic and accounts for its widespread misuse in sport. Testosterone has an anabolic:androgenic ratio of 1 whereas for nandrolone it is 10, revealing its powerful anabolic properties.

![Molecular structure of nandrolone or 19-nortestosterone.](image)

For the first time, nandrolone was synthesised in 1950. Since then, norsteroids were produced for broad therapeutic use in conditions like underactive sex organs, blood diseases or contraception. Athletes use nandrolone to accelerate muscle growth and increase lean body mass, strength and aggressiveness. Despite inconclusive scientific data, nandrolone is also used for faster recovery. Whatever the intention, the side-effects of nandrolone are dangerous for athletes.

Nandrolone can be injected or taken orally. Precursors such as 19-norandrostenedione or 19-norandrostenediol may also be used and are currently popular with nutritional prohormone supplements.

How nandrolone is degraded in the body

Once in the organism, substances go through a multitude of degradation steps that transform the original molecules into their active forms, into degradation products called metabolites that are excreted in urine, or both. Nandrolone metabolites can be detected in the urine for several days after oral ingestion or for months after intra-muscular injection. Elimination is strongly dose-dependent and individual.
A recent study by the Swiss Anti-Doping Laboratory, in collaboration with FIFA-Medical Assessment and Research Centre (F-MARC), showed a wide inter-individual variability in the elimination of the two main metabolites. It is likely that the absorption after oral intake is more variable than after an intramuscular injection. In any case, if a player tests positive for nandrolone, it is very difficult to know the moment and the method of use.

How doping tests detect nandrolone

The finding of a potential doping offence with nandrolone is based on the detection of the two major metabolites 19-norandrosterone (19-NA) and 19-noretiocholanolone (19-NE) in urine. Nandrolone has been on the banned list of the International Olympic Committee (IOC) since 1976. In 2004, the World Anti-Doping Agency (WADA) set the threshold for 19-NA at 2 ng/mL for both males and females. Modern analytical instruments are extremely sensitive and can detect traces of about 0.2 ng/mL 19-NA and 19-NE.

Where do nandrolone metabolites in urine originate from?

Over the last decade, there have been numerous doping cases involving nandrolone which has led to various hypotheses concerning the origin of nandrolone metabolites found in urine. FIFA participates actively in the investigation of these hypotheses performed by anti-doping laboratories.

Nandrolone produced within the body

Just before the 1998 World Cup in France, some positive doping cases raised the question whether the human body could produce traces of nandrolone metabolites without any intake of forbidden substances. In women, nandrolone has been found in the ovarian follicular fluid and in the urine during the 6th and 14th weeks of pregnancy. Regarding men, no clear answer can be given so far. Analyses performed by all of the WADA-accredited laboratories suggest that the concentration of a possible production by the body, if any, should lie below the cut-off value of 2 ng/mL in normally concentrated urine.

Nandrolone in nutritional supplements

Another hypothesis says that the nandrolone metabolites in the urine originate from the intake of nutritional supplements contaminated with nandrolone precursors. Laboratories investigated the actual composition of supplements available on the internet, in shops or in fitness clubs and found that both hormonal and non-hormonal dietary supplements are mislabelled and may contain anabolic-androgenic steroids or prohormones. The information about ingredients is generally suppressed in order to deceive sportsmen. There is a clear risk, therefore, of unintentional doping through their use.
This danger is not very well understood and cannot be stressed enough. It is important to know that beneficial effects of dietary supplements are not clearly established despite the numerous studies performed.

The contamination of creatine products is especially serious. The intake of the recommended daily dose of a creatine product contaminated with a nandrolone precursor for three days led to concentrations of nandrolone metabolites in urine near or above the limit of 2 ng/mL.

**For women only**

Female players have to be aware that some contraceptive pills or preparations taken to delay the onset of menstruation may contain norethisterone that can lead to positive test results for nandrolone metabolites.

**Nandrolone intake and physical effort**

Another question is a possible increase in excretion during or after strenuous physical exercise. A mechanism could be a release from fat tissues during effort. The laboratories of Lausanne and Montreal, financed by F-MARC, investigated 621 male subjects. The 137 amateur football players did not show any 19-norsteroid production at rest. After exercise, only nine showed traces of 19-NA and 19-NE. In the same study, 358 elite football players were tested after competition. The majority had an undetectable, or a value of less than 2.0 ng/mL for metabolites of nandrolone in the urine. There was only a single result over the limit of 2 ng/mL, which could have been due to previous intake of a contaminated supplement. In another study with 34 amateur sportsmen, the measurements of 19-NA and 19-NE in the urine were quite variable and did not appear to be significantly influenced by exercise.

Thus, physical effort can have different, but certainly no systematic effects on the excretion of nandrolone metabolites depending on an individual’s metabolism. These results indicate that no extrapolation is possible concerning pre- and post-effort 19-NA and 19-NE urinary levels.

**Conclusion**

In the case of a player who has been tested positive for nandrolone, individual case management has to be considered by the disciplinary panels when making any decision about sanctioning or follow-up.