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## Nutrition and exercise associated gastrointestinal problems

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*Gastrointestinal (GI) problems are a common concern of athletes during intense endurance exercise, in particular during races. In most studies the incidence of GI symptoms has been documented as being between 30-50%. Ultimately these symptoms can impair performance and possibly prevent athletes from winning or even finishing a race. The causes of GI problems during exercise are diverse, but among others include unaccustomed or inappropriate food and fluid intake. It is therefore vital for athletes to carefully select and test their food intake before race day.*

It has been demonstrated that exercise at high intensities leads to a redistribution of blood flow such that the priority becomes to nourish the exercising muscle. This leads to a reduced blood flow into the gut of up to 80%. It has been suggested that alongside changes in nervous activity and altered hormonal responses during exercise this can lead to the development of GI symptoms. The exact causes of GI symptoms, however, are incompletely understood. On top of these exercise induced GI problems; race nutrition can exaggerate or cause a number of GI problems.

### *What are common symptoms during exercise?*

A variety of different GI symptoms can occur during exercise (see Table 1). The reported prevalence of these symptoms varies in different studies depending on the method of investigation, study population, sex, age and training status of the athletes as well as mode and intensity of the exercise studied. Mostly a prevalence of 30-50% is reported (for review see (1)).

**Table 1:** Common symptoms during exercise

Upper abdominal problems	Lower abdominal problems
Reflux/Heartburn	Intestinal / lower abdominal cramps
Belching	Side ache / stitch
Bloating	Flatulence
Stomach pain / cramps	Urge to defecate
Vomiting	Diarrhoea
Nausea	Intestinal Bleeding

### *Who is likely to get GI problems?*

The prevalence of GI problems varies between different individuals. Generally, females are more likely to experience GI distress than male. This is especially true during menstruation when women tend to experience more gastrointestinal distress. Younger athletes appear to be more susceptible to GI problems than older athletes, which might be due to increased years of training as well as a better experience in terms of the right feeding strategy in the older athletes. It is also known that training status is negatively correlated with the incidence of GI distress (for review see (1)).

Apart from those "risk factors" there still appears to be an individual sensitivity of athletes. In a set of recent studies where we investigated tolerance of different carbohydrate gel intakes during intense running, a consistent finding was a strong correlation between a history of GI distress and the reported GI symptoms during the trials. This suggests that an individual predisposition to GI problems during exercise exists (4).

# TOPICS



## *During which sports are GI problems most likely to occur?*

The likelihood to suffer from GI distress varies between different modes of exercise. GI problems are more common during running than during cycling (3) or any other sport where the body is in a relatively still position such as cross country skiing or swimming. This might be due to enhanced mechanical stress on the GI tract as a result of the bouncing nature of running.

However, not only the mode of exercise but also the exercise intensity plays a role in the development of GI distress. Lower exercise intensities have no effect on gastric emptying and if anything seem to have a regulating effect on colon transit. In contrast high intensity exercise delays gastric emptying. The blood flow to the gut decreases in proportion to the exercise intensity and GI problems are more likely to occur when the exercise intensity is increased.

Furthermore, a prolonged duration of exercise increases the risk for development of GI distress compared to a short bout of exercise. Towards the end of long races when many athletes become progressively more dehydrated, GI symptoms are more common.

Independent of the sport, race day is always associated with increased psychological stress. Consequently a further attenuation of symptoms through nervous and hormonal changes under stress is likely to occur on race day.

## *Which foods can cause/exaggerate GI problems?*

Given the increased stress on the gastrointestinal tract during races, it seems obvious that the athlete has to carefully select foods which are tolerated well and care needs to be taken with foods that might cause problems (see table 2).

The digestive process of food in the human body can take about 24 to 72 hours. This suggests that not only the food intake on race day can influence GI comfort but also the nutrition on the days leading up to the race. A high intake of fibre is known to delay gastric emptying of foods, increase intestinal bulk and colonic filling. The observed relationship between occurring GI symptoms during exercise and a diet high in fibre seems therefore not surprising. Similarly a diet high in fat is associated with GI distress during exercise, probably due to delayed gastric transit of foods high in fat.

With a prevalence of 2-30% in Northern Europe (~70% in the world's population) lactose intolerance is one of the most common food intolerances. While the sensitivity to lactose is caused by a lack of lactase in the gut the severity of symptoms is dependent on the amount of lactose consumed and the degree of lactase deficiency. It is possible that lactose intolerance is not recognised by an athlete when symptoms during rest are mild. However, there remains the potential that the intolerance can lead to problems during intense exercise when lactose has been ingested.





*Table 2: Foods and supplements which may upset the GI tract*

Fibre and Fat before and during the race
Hypertonic solutions before and during the race
High carbohydrate intake (in some individuals)
Lactose (if intolerant)
NSAID (e.g. aspirin, paracetamol, ibuprofen)
Sodium bicarbonate, sodium citrate
High doses of Caffeine
High doses of minerals (e.g. Iron, Magnesium)

Not only is the composition of the food intake crucial to consider for an athlete on race day, the timing is important as well. A large food intake especially when high in fat, fibre and protein could upset the stomach, especially when eaten less than three hours before the race.

During races, dehydration is commonly linked to GI distress. In runners, voluntary fluid intake during races seems to be rather small and dehydration is common (5). It is often mentioned by runners that they do not feel comfortable when taking in larger amounts of fluid. On the other hand low fluid intake can lead to dehydration especially in hot conditions and can become a risk for GI distress. Interestingly, a recent study showed that the comfortable intake of fluid while running can be increased by training. Runners received a calculated amount of fluid in order to match their sweat loss during repeated training sessions and had to rate their GI discomfort. Perceived stomach comfort with a similar amount of fluid ingested was significantly improved in run 5 and 6 compared to the first training session (2).

The choice of drink during exercise has also been associated with the risk of GI symptoms during exercise. Hypertonic drinks have been related to GI discomfort. As a possible mechanism it is speculated that hypertonic solutions can cause net secretion of fluid into the gut and therefore can lead to abdominal problems such as loose stool and diarrhoea. However the degree to which hypertonic carbohydrate drink can lead to GI symptoms is not conclusive among studies.

In contrast, we showed in a recent study that high amounts of carbohydrate gels delivering up to 90g carbohydrate per hour had been well tolerated from the majority of runners during a 16km race (4). Nevertheless, in this study some runners showed severe problems. This leads us to the conclusion that tolerance of high carbohydrate intake is different between individuals and the advice for athletes is to test their food and fluid intake during intensive training sessions or a test race before the actual event.

Other considerations for athletes are possible side effects on the GI tract from substances used as supplements or medication. For example caffeine can have a laxative effect on the GI tract and high doses may lead to GI problems during exercise. Sodium bicarbonate and citrate used as buffering supplements are also reported by athletes to cause gastrointestinal problems such as vomiting and diarrhoea. Commonly used non-steroidal anti-inflammatory drugs (pain killers such as aspirin, paracetamol and ibuprofen) are linked to GI distress, especially when used in high amounts which appears to be common in some athletes.

# TOPICS

## *What can athletes do to prevent GI problems?*

- The occurrence of GI distress is highly individual. Testing of food and drink intake during intense training or less important races is vital.
- Training of fluid intake especially during running can reduce discomfort
- Sufficient fluid intake before and during the race (euhydration)
- Avoid fibre rich food (e.g. beans, bran, fruits, seeded or wholemeal bread) intake in the days before the race and during the race
- Avoid high fat foods in the days before the race and during the race
- Allow sufficient time (>3h) to digest the last meal
- Test your tolerance of lactose and if sensible avoid dairy products before the race
- Caution with NSAID (pain killers such as aspirin, paracetamol, ibuprofen etc.)
- Test use of caffeine before. Possibly reduce dose or split intake into smaller doses
- Test use of sodium bicarbonate or citrate
- Stress management in order to keep psychological stress on race day low
- Adapt intensity to allow normal gut function

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