

Taste of nicotine

FREDRIK H NYSTRÖM

Preface

PROFESSOR FREDRIK NYSTRÖM TEACHES future doctors at Linköping University and has long been an extremely productive researcher. A researcher who has succeeded in combining his own research with writing more accessible popular scientific texts. Last year saw the publication of his book “Radically Lagom – how to live a long and happy life without exercising, dieting or stressing yourself to death”, which has already run to several editions. In the book, Fredrik Nyström describes both slightly controversial topics such as how dieting and getting thinner doesn’t always lead to a healthier and longer life, and how red wine can be good for you, as well as more accepted truths such as the fact that reasonable amounts of exercise are preferable to extreme, long and demanding races.

Fredrik Nyström has been part of several evaluations by SBU, the Swedish Agency for Health Technology Assessment and Assessment of Social Services. He was also one of the first to question the long accepted rule that fat is the primary cause of overweight and obesity. Several studies led by Nyström point to the unwanted weight increase instead being caused by both fast and slow carbohydrates. A not entirely uncontroversial statement in established obesity research circles in Sweden. Fredrik Nyström recently published a new research study that investigates the direct physical effects of nicotine. Here he shows that very little seems to happen in the body when a pouch of snus is placed under the lip.

It’s a brave researcher who states that we need to take it easy with exercise and that we shouldn’t be afraid of either a glass of red wine or a little fat in our food. But it creates something of a stir when that same researcher also dares to claim that nicotine, in the form of snus pouches, seems to have no significant effect on the body. At EPHI, we are therefore very happy to present a report by Fredrik Nyström on snus and its effects

on the body. A report that builds on the research study published by Fredrik Nyström in Drug and Alcohol Dependence Volume 236, 1 July 2022¹.

IN SWEDEN, WE HAVE ALMOST ACHIEVED THE WHO GOAL OF BEING SMOKE-FREE, which is defined as fewer than 5% of the population being daily smokers. One contributory factor is the availability of another way to use nicotine – snus. Despite the fact that snus has a long history in Sweden and there are around 1 million users, surprisingly little research has been carried out into the effects of nicotine. The research that does exist is old and in many cases completely obsolete. This has led to a widespread perception amongst many people in leading positions within the health sector that snus is something that, like cigarettes, should be opposed with strict methods. But it is perhaps time to completely revise our view of snus.

Instead of seeing it as something that should be opposed, perhaps it should be regarded as a relatively inoffensive method of obtaining a nicotine hit. A method that we could perhaps try to communicate to the rest of the world. We should quite simply contribute to a smoke-free world at global level by daring to highlight a Swedish success story. Here, it's possible to get your daily dose of nicotine without needing to die from COPD or lung cancer. There are currently 1.3 billion smokers in the world, and it is expected that half of these will die from smoking. Snus could make a big difference to this number.



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¹ <https://pubmed.ncbi.nlm.nih.gov/35580478/>

Taste of nicotine

Tobacco has been used by people for more than 1000 years. The nicotine in tobacco has left users wanting more and the tobacco leaves have been treated in a variety of ways to get hold of the nicotine-effects. They have been chewed, smoked and taken as snuff. In Sweden, we enjoyed the nicotine in tobacco long before the arrival of coffee as another stimulant option – or perhaps rather as a complementary drug.

In Sweden, people began to cultivate snus in the middle of the 18th century and by the 19th century, the habit of placing snus under the lip (which is the typical Swedish way of using snus) increased in popularity. By then, a vast amount of Swedes both consumed and cultivated snus. The industrialised and standardised production of snus entered during the 19th century and many impactful snus brands saw the light during this era. The first portioned snus in Sweden came during the 1970's. This meant that the snus was sold in small, prepackaged pouches that are tucked under the lip, whereas before the consumer had to press and form the loose snus into an adequate portion. A few years ago, nicotine pouches, which resemble portioned snus but, unlike snus, do not contain tobacco but only nicotine, flavorings and fibers, was launched.

So, when I use the Swedish word snus, it is this product I am referring to as well as the method of placing an already packaged portion of snus under the lip or a smaller amount of loose snus. "Snuff", on the other hand, is a broader term referring to several different ways of consuming tobacco, such as chewing tobacco or inhaling tobacco through the nose. In contrast to many other forms of treated or cured tobacco, modern Swedish snus is almost never fermented, hence there is a very low amount of so called nitrosamines, a byproduct of fermentation that might not be completely safe.

Both coffee and nicotine raise the blood pressure when they reach their cellular receptor in the human brain. When I studied medicine in the 1980s, we were advised not to drink coffee. It was considered to be far too stressful for the heart and blood vessels. Both of these substances, caffeine and nicotine – or if you prefer the word, drugs – raise the pulse and blood pressure and make us more alert. And both caffeine and nicotine can cause addiction. It is also common for these substances to be used at the same time. You quite simply smoke a cigarette with your coffee. A scientific finding that many might find controversial is that the combination of nicotine and caffeine effectively suppresses hunger². This is not entirely uninteresting, given that large areas of the world are now plagued by obesity, leading to a great deal of ill-health.

But in Sweden, smoking is now almost extinct. We are at, or slightly below, the level defined by the WHO as a smoke-free country. However, nicotine has still been permitted to affect our central nervous systems on a relatively constant level, because we were gratuitously granted an exemption within the EU to continue the use of snus. In Norway, too, snus can be consumed, as the country is not a member of the EU. But this highly limited geographical use of a smoke-free nicotine product is one important reason that there is very little scientifically strong data on any risks – or benefits – by putting snus under the upper lip.

I confirm here in the introduction to this essay that nicotine is addictive, and that of course this is a cause for concern. Dependency of any type can often be a burden and establish limits on everyday life. Against this background, this particular non-nicotine dependent but excessively caffeine consuming author would like to share with you, dear reader, his personal, medical and scientific viewpoints on the role of nicotine. I intend to compare the risks and benefits with other addictive substances and behaviours, particularly in the form of caffeine consumption.

² The appetite-suppressant effect of nicotine is enhanced by caffeine A. Jessen et al. Diabetes Obes Metab 2005 Vol. 7 Issue 4 Pages 327-33.

I have recently published a scientific article on the acute medical effects of snus with or without nicotine. In short, to my surprise I could not find any particularly strong metabolic effects of the nicotine. Snus quite simply seems to have very few effects on either important hormones or blood glucose regulation. For me, this was quite unexpected, since I checked a vast array of metabolic effects through blood samples every hour, and also by measuring the total metabolic rate by carbon dioxide production and oxygen consumption. This means that there is medically very little scientific support for many politically motivated supporters of a general ban on snus.

NATURAL NICOTINE

Nicotine can be found in a number of plants in the potato family, with the tobacco plants, primarily *Nicotiana Rustica* or *Nicotiana Tabacum*, containing particularly high levels. In other words, nicotine is produced by ordinary potatoes, as well as tomatoes and aubergine, even though at low levels. Nicotine is thus a commonly occurring natural product, the function of which is to protect the plant against insect attacks. In purified form it has been used by man to protect against insects since the late 1600s. Indeed, many modern insect repellents are derivatives from nicotine. Nicotine and caffeine are both fat-soluble substances, and both these drugs can thus easily cross what's known as the blood-brain barrier that otherwise prevents most substances from reaching into the central nervous system from the bloodstream.

Caffeine and nicotine affect completely different receptors in the brain, but both ultimately have effects including an increase in the level of the neurotransmitter glutamate (a substance used by nerve cells to send signals to other cells). This type of signal molecule is often linked to a range of invigorating and stimulating effects in the central nervous system. When the nicotine reaches its receptors in the brain, many of us both feel and perform better. Based on my current review of the scientific literature in this area, we should probably consider nicotine as more effective than caffeine in such regards. For example, an anti-depressant

effect of nicotine comparable to that of medication has been demonstrated in humans³.

It is also clear that there is stronger scientific documentation that nicotine is genuinely more effective than caffeine at making individuals sharper and more precise in a range of tests aimed to assess reaction times and accuracy when carrying out complicated tasks within strict time limits. I can see this myself from personal experience. A high dose of caffeine definitely makes me more alert, and I also find it much more difficult to fall asleep. But, at the same time I become rather jitterish and ultimately unfocused at very high doses. In my case, more than 1 litre of coffee. In contrast to this, it has recently been demonstrated that skilful archers perform even better when using nicotine chewing gum compared to placebo⁴. Other recent studies have demonstrated that individuals become better at facial recognition⁵ and can hear better⁶ when using smoke-free nicotine in placebo-controlled studies.

A BRIEF HISTORY OF NICOTINE

Archaeologists have found evidence of humans using tobacco as much as 12,000 years ago. It's said that Christopher Columbus tried out cigarettes when he reached the "New World" in 1492. In 1560, Jean Nicot de Villemain, the French ambassador in Portugal, sent tobacco seeds to the King of France, praising their medical use. At that time, it was most common in Europe to take nicotine in the form of snuff. In aristocratic circles, tobacco was viewed as modern and often considered to be good for the health. Catherine de' Medici, the Queen of France, was so pleased with the effect of snuff on her migraines that she declared it should henceforth be known as Herba Regina (Queen Herb). Later, in the 18th and 19th centuries, cigars overtook snuff in popularity. But it was still only those with strong finances who consumed tobacco to any great extent.

³ Effects of long-term administration of nicotine and fluoxetine on sleep in depressed patients R. Haro et al. Arch Med Res 2004 Vol. 35 Issue 6 Pages 499-506

⁴ Nicotine supplementation enhances simulated game performance of archery athletes. B. L. Hung et al. J Int Soc Sports Nutr 2021 Vol. 18 Issue 1 Pages 1.

⁵ Short-term effects of nicotine gum on facial detection in healthy nonsmokers: a pilot randomized controlled trial T. P. Fernandes et al. J Addict Dis 2021 Vol. 39 Issue 1 Pages 15-25.

⁶ Nicotine gum enhances visual processing in healthy nonsmokers T. P. Fernandes et al. Brain Imaging Behav 2021 Vol. 15 Issue 5 Pages 2593-2605.

A broader interest in nicotine grew when it was learned that chewing tobacco could suppress hunger and increase productivity. Chewing tobacco became an early habit amongst seamen and mineworkers – in other words, professions where it could be particularly difficult to obtain food. Modern studies confirm that nicotine reduces the appetite and also that an increased energy expenditure contributes to lower body weight amongst those who use nicotine⁷. Correspondingly, it is widely known that a significant weight increase often follows when someone quits smoking. Soothingly, this bothersome side-effect is possible to counteract through the use of smoke-free nicotine patches⁸.

Sweden reportedly has the longest history of snus use in Europe. It was introduced to the country in the early 17th century, and as elsewhere first became popular amongst the aristocracy. This first historic snus usage reached a peak in around 1919, falling as the use of cigarettes became widespread. But smoking has fallen continuously in Sweden since the 1970s, while nicotine intake through snus has increased. At least 12% of the adult Swedish population now admit to being daily snus users, and around a further 3% are occasional snus users.

THE POWER OF HABIT

But nicotine isn't the only substance often used to increase enjoyment in our lives while exercising some control over our habits and behaviours. As mentioned, caffeine is another example that often goes hand in hand with nicotine consumption. A craving for caffeine often makes itself felt in the morning, with a yearning for the warming and invigorating drink with its appealing scent wafting from the coffee maker. In any case, that's how my body works. Many people feel their ability to effectively cope with their work is limited if they have not had their morning cup of coffee.

⁷ Nicotine and energy balance A. Schwartz and N. Bellissimo. *Appetite* 2021 Vol. 164 Pages 105260.

⁸ Effects of three doses of transdermal nicotine on post-cessation eating, hunger and weight J. R. Hughes et al. *J Subst Abuse* 1997 Vol. 9 Pages 151-9.

Caffeine and the consumption of coffee – or for that matter, tea – are clearly habit-forming and also addictive⁹. You risk abstinence if you don't get your caffeine hit in the morning. Many people even develop headaches indicating a failure to activate the caffeine receptors if they don't get their coffee. And it's exactly the same thing, perhaps even more clearly, with nicotine. Smokers often feel an increased sense of calmness and ability to focus after just a few drags – in other words, within half a minute, as a result of the rapid nicotine uptake from the tobacco smoke. Neither snus nor coffee work this quickly to stimulate the corresponding receptors in the brain.

While the nicotine in the cigarette smoke gives rise to such rapid activation of the receptors, it's foremost the smoke from the burned tobacco leaf that damages the lungs and can lead to cardiovascular disease and cancer. One very concrete effect of cigarette smoke is that the cilia, the tiny hair-like projections that clean and remove debris from the airways, are damaged by the smoke so that many harmful substances remain for too long in the lungs. Smokers can develop chronic obstructive pulmonary disease (COPD), asthma and emphysema as a result of the smoke. Indeed, this can occur as a side effect both of poor urban air quality and from tobacco smoke.

Sadly, much of the damage caused by smoking doesn't really heal at all when you stop smoking. Different types of cancer resulting from tobacco smoke can unfortunately appear decades after having given up smoking. In many scientific publications investigating the potential risks linked to the use of snus, insufficient statistical corrections have been carried out to take into account that current snus users were often previous smokers. In effect, there still remains an increased risk for many diseases from the previous smoking during the use of snus, only. This has resulted, for example, in snus being blamed for conditions such as bronchial, esophageal and pancreatic cancers without taking account of the fact that many of these individuals were long-term smokers or had other risk behaviours which also correlate with smoking¹⁰.

⁹ Yes, tea – both black and green – also contain caffeine. In lower concentrations than coffee, admittedly, but on the other hand tea drinkers often consume larger volumes.

¹⁰ Snus: a compelling harm reduction alternative to cigarettes <https://pubmed.ncbi.nlm.nih.gov/31775744/>.

Also, it might be good to know that the minor damage to the mucous membranes that snus users often develop under the lip can heal quickly if the position of the snus is changed. So, it is perhaps not so surprising that there is no hard scientific evidence for the claim, by some, that “you get oral cancer from snus”. I know, I have searched in vain for any such convincing published studies.

THE DAMAGE GOES UP IN SMOKE

In Sweden we consume as much nicotine as in many countries with high smoking prevalence. But when you compare ill-health linked to cigarette smoking in other countries with the situation in Sweden, where the nicotine nowadays largely comes from snus, we have an almost total lack of lung-related illness.

In a recent literature review on the subject, it was estimated that essentially all lung damage occurring as a result of cigarette consumption goes absent when the nicotine is instead consumed via snus. As a physician, I am curious as to why it is considered (by many colleagues of mine) to be inappropriate for an individual to replace cigarettes with snus if the aim was to cope with the nicotine abstinence from having quit smoking? I have had many patients who have succeeded in stopping smoking by switching to snus, and I do congratulate them. There are also plenty of published scientific observations that demonstrate that it is possible to successfully quit smoking if the individual is instead provided with nicotine through the use of snus.¹¹

PIPING HOT DATA

As mentioned earlier, I have recently published a study indicating that nicotine in snus has very few and small direct risk effects on the body¹². I compared snus with and without nicotine to see how powerfully stimulating the nicotine effect might be, but found, almost to my

¹¹ Snus: a compelling harm reduction alternative to cigarettes <https://pubmed.ncbi.nlm.nih.gov/31775744/>.

¹² In the high quality journal Drug and Alcohol Dependence: <https://pubmed.ncbi.nlm.nih.gov/35580478/>.

disappointment¹³, that it was only blood pressure and the hormone cortisol that increased a little when the individual replaced the snus pouch every hour from breakfast to lunch. The systolic blood pressure increased by a few mmHg compared to the study days during which research subjects used nicotine-free snus instead. This can be compared to a study (not carried out by me) of the effects of sports drinks with and without caffeine, where the effect on blood pressure was almost doubled – a full 5 mmHg increase – by caffeine.

If you consider that in several studies, caffeine has been shown to be linked to reduced cardiovascular disease, and even some cancers, and that the effect is dose-dependent, with better protection the more coffee you drink, at least up to 4 cups per day¹⁴, you immediately realise that not everything that stimulates and gives us a little pleasure also has to be hazardous. There is also corresponding data that caffeine increases the stress hormone cortisol a little, and that was my other clear discovery during my snus study, the cortisol level in the blood was increased by the snus-derived nicotine. Clinically, it is very clear that the hormone cortisol has a stimulating effect in the short term. This is a hormone that is an important part of the normal stress reaction, where the purpose is to make the body and mind clear and sharp when subjected to various types of stress, danger and demands. In other words, the cortisol level in the blood rises naturally when you are exposed to mental or physical stress.

In another scientific study, I have earlier demonstrated that cortisol rises in a surprisingly powerful and prolonged way if you begin your day by running five kilometres. However, that stress-derived increase in cortisol remained right into the late evening¹⁵. And jogging is an activity that isn't at all prohibited, despite that it also sharpens the senses and increases the blood pressure and stress hormones in a much clearer and longer-term manner than starting the day with a cigarette or coffee. Also, during a standard treadmill test that we routinely carry out in the healthcare system to investigate the fitness, or cardiac disease, of a patient, it's perfectly normal for the systolic blood pressure to rise by 70 mmHg. In

¹³ As a researcher, it is easier to get studies showing strong effects published in quality journals. I have struggled against this for over 25 years now (I obtained my doctorate in 1997) and have now published more than 150 scientific papers, implying that I also must have had papers rejected more than 400 times. I have chosen not to keep count.

¹⁴ Coffee consumption and health: umbrella review of meta-analyses of multiple health outcomes R. Poole et al. *BMJ* 2017 Vol. 359 Pages j5024.

¹⁵ So-called free cortisol. See link <https://pubmed.ncbi.nlm.nih.gov/28622349/>.

other words a full 20 times more than from nicotine from snus in my study. I bring this up because I have seen it stated that nicotine causes strokes because it raises the blood pressure. This reasoning undoubtedly has its roots in the blood pressure reactions. If these assumptions were true, jogging would truly be lethal, if it was that easy to calculate risks based on such statistical linkages to blood pressure surges.

But remember that nicotine can lower the body weight by both increasing energy expenditure and reducing hunger, as previously mentioned in this text. This naturally counteracts increased risks that could theoretically result from slight increases in blood pressure.

When you consume nicotine, you often experience increased attention and concentration. Many people also report that nicotine can have a calming, anxiety-reducing effect. An observation that agrees with this is that people with various mental illnesses are smokers to a particularly large extent, and that they also find it particularly difficult to stop consuming nicotine.

This effect of sharpening the senses, which clearly also relieves many disabling mental symptoms, is so evident that new medications are now being developed to activate the nicotine receptors. These new medications will be tested on conditions such as Parkinson's disease, Alzheimer's and ADHD; conditions where several studies have demonstrated that nicotine appears to be protective and palliative. For example, there are studies that have demonstrated improved memory in dementia¹⁶, and reduced ADHD symptoms¹⁷ with the use of nicotine. A study was also recently published that demonstrated less pain and swelling after tooth removal following the application of nicotine patches¹⁸.

¹⁶ Nicotine treatment of mild cognitive impairment: a 6-month double-blind pilot clinical trial P. Newhouse et al. *Neurology* 2012 Vol. 78 Issue 2 Pages 91-101.

¹⁷ Effects of chronic nicotine and methylphenidate in adults with attention deficit/hyperactivity disorder E. D. Levin et al. *Exp Clin Psychopharmacol* 2001 Vol. 9 Issue 1 Pages 83-90.

¹⁸ Effectiveness of nicotine patch for the control of pain, oedema, and trismus following third molar surgery: a randomized clinical trial. F. S. Landim et al. *Int J Oral Maxillofac Surg* 2020 Vol. 49 Issue 11 Pages 1508-1517.

RISKS, DEBATES AND POLITICS

In the USA, there was once a discussion of whether caffeine dependency should be classified as such an addictive substance that it should be allocated a medical diagnosis code. But this resulted in a controversy about whether this would trivialise other diagnoses, and whether it would bring far too many everyday problems into the domain of psychiatric illness. Ultimately, no code was allocated to caffeine addiction, but many arguments were made that it is a genuine clinical problem for so many young people to consume such large quantities of caffeine which are ‘abused’ together with other things such as sweets.

Politicians here in Sweden have also considered punitive taxations on sugar. This makes me wonder what our politicians think about the themes of this report. What are the current strategies for dealing with addictive substances? It turns out that the Social Democrat government drew up a strategy for alcohol, narcotics, doping, tobacco and gambling policies, the so called “ANDTS” strategy.

“The job to reduce the damage caused by alcohol and gambling, to counteract narcotics and doping and to reduce tobacco use is a central focus of the government’s public health policy”, according to Lena Hallengren, former Minister of Social Affairs.

Sweden already had an ANDT strategy dating back to 2011, but this did not include gambling (the final ‘S’, for ‘spel’ or ‘gambling’ in Swedish). In other words, the new policy increased the prohibitions by adding the S to refer to gambling addiction. The purpose of the strategy was to provide goals and directions for how society’s efforts in the ANDTS areas were to be implemented during the period 2022–2025. The previous Social Democratic government has also stated that all freely sold nicotine products should be regarded as “equally harmful to the health”. This is regardless of whether the product is snus, nicotine pouches, e-cigarettes or traditional cigarettes. The government’s investigators also suggested that all flavours of e-cigarettes except for tobacco flavour¹⁹ should be prohibited. But this prohibition on flavours was rejected by the Swedish Parliament on 21 June 2022.

¹⁹ E-liquids are manufactured from glycerine and propylene glycol, which are relatively tasteless substances. Some sweetness is often experienced due to the glycerine. In this case, the ‘tobacco flavour’ is an artificial flavour that can be composed, for instance, of vanilla, caramel, smoke aroma and spices such as cinnamon, honey, herbs and various fruits.

TASTE OF NICOTINE, COFFEE AND BREAKFAST

It is clearly a problem that individuals quickly can become nicotine-dependent. But this is a side effect that frequently results from substances, or even activities, which provide some kind of hit combined with sense of increased focus and control. For example, many people are dependent on eating breakfast. I know this from my experience as a doctor when having to adjust the insulin doses for my patients, who then require an additional injection for the extra breakfast meal if they are on modern multiple insulin dose treatment. An extra injection that is not necessary if the patient doesn't eat breakfast but instead, like me, simply starts the day with a large cup of coffee²⁰.

The point I am trying to make here is that there is more than one addiction for the "ANDTS movement" to address if all types of addictive behaviours must be prohibited. I, on the other hand, believe that individuals should be given correct information about the potential risks associated with various choices and behaviours, and should decide for themselves whether the benefit and joy outweigh the risks of addiction, muscle damage or extra insulin injections.

THE SEEKING FOR SOME STIMULATION

I think it is strange to have attempted to legislate against flavouring nicotine in an e-cigarette when it can replace the nicotine coming from a true combustion-based cigarette, so that you get rid of the smoke. I have also heard it said that, from a legal viewpoint, to be effective laws should feel comprehensible and justified. How can it feel meaningful to try to prohibit a fruity e-cigarette? Particularly as it is so easy to add your own fruit flavour by manually composing your own e-liquid?

As a researcher, I find it difficult to accept that a self-appointed moral – but not scientific – authority should decide for us underlings what risks and kicks we should be allowed as a little comfort and enjoyment during our short time on planet earth. At the same time, many people in my professional sphere (both within the Regional healthcare system and at the University) worship excessive exercise as an activity that they seem to think acts as a panacea (a cure for everything) despite the fact that it

²⁰ I must point out here that the dietary regime demonstrated to reduce cardiovascular disease compared with low fat or Mediterranean diets is traditionally a regime without breakfast.

can also make practitioners addicted to the morphine produced by their own bodies (endorphins) when their tendons and muscles are subject to micro-damage – which can also give rise to delayed onset muscle soreness and inflammation. I find this extremely contradictory. But I know that the information often comes from colleagues in the Royal capital, i.e. Stockholm. In other words, in the same city where the Regional healthcare system has just invested in a dedicated ‘sport cardiology clinic’ at the Karolinska Hospital, which aims to become “a Swedish centre for heart problems linked to sport”. Do they want more patients, to gain a sense of being important?

When I studied medicine in the 1980s, coffee was something that we were advised to avoid, as it was considered to cause so much bodily stress that the heart could lose its steady rhythm. In fact, new data links coffee to reduced life risks, with a dose-related relationship – effects that are better and better the more you drink, as I have already mentioned. Furthermore, as a medical student 40 years ago, I was taught that being completely teetotal, exercising hard, staying thin and avoiding caffeine was the way to go.

Interestingly, clear new data have now been published that shows those who exercise frequently and intensely have an increased occurrence of both cardiac scarring and severely irregular heartbeats – atrial fibrillation. Anyone having competed five or more times in Vasaloppet, the Swedish long-distance ski race, has three times as great a risk of developing atrial fibrillation as those who settled for only one Vasaloppet²¹. That’s how ‘beneficial’ intense training for several long-distance races is for the heart. But I still think you should be allowed to choose to participate in such races if you want. You should simply have the information about both the benefits and risks, which should not be based on purely political ideas of what is considered to be healthy. Instead it should be based on hard scientific facts. If you don’t injure yourself while you train for Vasaloppet, of course you develop better stamina and condition. But many people are not aware that you also cause a good deal of wear and tear to the electrical wiring in the heart. And that the cardiac-muscle does not give you the same warning signals as the post-exercise muscular-derived pain provides.

²¹ See the article here: <https://pubmed.ncbi.nlm.nih.gov/23756332/> see figure 1 page 3627.

How well our hearts resist an irregular heart rhythm varies from one individual to another. Furthermore, in the same study of Vasaloppet, it was shown that such chronic exercise also wears out the joints in many participants, in proportion to how many races one has finished. A great deal of the Vasaloppet-skiers developed osteoarthritis from all the training. And, indeed, those who had exercised most, those who had participated in the most races, developed most osteoarthritis²². But if you want to exercise hard because it makes you so happy and alert, then you should be allowed to do so! If the total joy outweighs all the suffering and side-effects you accumulate during your lifetime, you should be allowed to choose what brings you joy, even if it's a bit risky for both your heart and joints.

IT SHOULD BE A FREE CHOICE TO STOP OR TO CONTINUE

I think people should receive sufficient training and information so that we can make our own choices and develop our own combination of enjoyment, joy and risks in life. If you really want to play games and drink cola-flavoured caffeinated beverages, I think you should be allowed to do so. And if nicotine from snus or e-cigarettes gives you an even greater ability to press the right button on the computer gadget at the exact right moment – which studies show is often the case – then I think you should be allowed to do that too. Snus doesn't damage the lungs. It barely damages your teeth or lips, and you do not significantly disturb your surroundings when you are snusing.

Nicotine has been around humans for so long because it gives many of us the feeling of both increased control and relaxation in a stressful world. We have very recently had a scientific article published where we statistically equated patients with diabetes regarding all possible risks of premature illness. We selected a group of participants who often felt happy and full of pep and compared it to another that felt happy or alert less often. We found that the people who experienced such joy and vigour more often also retained cardiovascular health for

²² There was about 50% increased risk for those who had completed five or more races than for those having finished one race: <https://pubmed.ncbi.nlm.nih.gov/21479136/>.

longer, despite these feelings being the only difference between the groups²³.

What I am trying to communicate is that it's important to allow yourself joy in life. And if the sum of joys can be increased by using a drug in which the negative effects on the risk factors for cardiovascular disease are almost non-existent, then you should be allowed to give yourself the additional boost of the higher brain function that, for instance, nicotine from snus can provide. Recently, an article was published demonstrating that archers hit higher scores after consuming nicotine. So carry on with both nicotine and coffee, if you enjoy these natural drugs, but exercise in individual moderation – you'll increase your chances of a long, healthy, and joyful life!



A handwritten signature in black ink, appearing to read 'Fredrik H Nyström', with a long horizontal flourish extending to the right.

Fredrik H Nyström
MD PhD Professor

²³ Sense of vitality is associated with cardiovascular events in type 2 diabetes independently of traditional risk factors and arterial stiffness. *Diabetic Medicine* 2022 Aug 20;e14938. doi: 10.1111/dme.14938. Online ahead of print.



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