BBC

Compared to other apes and indeed all other mammals, humans are practically bald, and this may have allowed our species to thrive

By Melissa Hogenboom
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Look closely at your friends, family and even strangers. Spot anything strange?

Ignore any large noses or unusually-shaped brows. Instead, look at their hair – or rather, the lack of it.

It might not seem strange, because we are used to having relatively little hair covering our bodies. But when we compare ourselves to the rest of the mammals, and our closest living ape cousins, it is downright bizarre that we are the only large-bodied mammal with so little of it.

Unlike hairy chimpanzees and bonobos – and all other primates – most of our skin is on display. We have evolved this way, even though fur is beneficial: it insulates and protects the skin, and in some cases acts as a useful camouflage. So if it is so advantageous, why did we lose so

much of it?

We have very little hair when we are born (Credit: Cultura RM/Alamy)

It was Charles Darwin who first taught the public that humans are descended from an ape-like ancestor. He also wondered why we had so little hair.

Something must have created an evolutionary pressure for these hominins to lose their fur

"No one supposes that the nakedness of the skin is any direct advantage to man; his body, therefore, cannot have been divested of hair through natural selection," **Darwin wrote in *The Descent of Man***.

He proposed that we lost much of our fur due to sexual selection: we preferred hairless mates, and that is why hairlessness became common.

But that cannot be the whole picture. Before a preference for hairlessness began, we first had to start losing hair.

Our earliest human-like ancestors, known as hominins, were ape-like.

For them, fur would have been useful, keeping them warm on cold nights.

Something must have created an evolutionary pressure for these hominins to lose their fur.

Our closest living relatives have much more hair than us (Credit: Martha Holmes/Naturepl.com)

A few million years ago, there were several hominin species roaming the Earth. These included **the famous fossil known as "Lucy"**, an *Australopithecus afarensis* from 3.2 million years ago.

> *If the hominins were covered in hair, they could not have lost heat fast enough*

These hominins were ape-like. Lucy was a lot like a chimpanzee, except that she could walk upright and had a slightly bigger brain. Her skin was not preserved, but she was probably covered with fur.

However, between two and three millions years ago our ancestors began to inhabit more open savannahs. This meant they were out in the Sun's glaring heat for many more hours each day.

Around the same time, **they also started to hunt and eat more meat** – and game animals were more abundant in the open. This move into open spaces offered an explanation for our lack of hair.

Lucy could already walk upright 3.2 million years ago (Credit: Elisabeth Daynes/SPL)

In the 1990s, **Peter Wheeler** of Liverpool John Moores University in the UK came up with a mathematical model showing how much excess heat hominins would need to lose in open habitats in order to function. If their brains got too hot, their thought processes would be impaired.

If the hominins were covered in hair, they could not have lost heat fast enough. Wheeler reasoned that two related changes happened that allowed our ancestors to keep cool.

> *Early humans could keep going because of their ability to*

One was an upright gait. Walking on two legs meant that only the tops of their bodies were under direct sunlight.

But the hominins also started running long distances. This meant they could bring down large game animals by running them to exhaustion, but

"dump the heat" via sweating

it also put them at risk of over-heating. To cope with that, they needed to lose their fur – in order to help them sweat.

Hominins as hairy as chimpanzees could not cope with blazing midday sunlight. Unable to hunt or forage, they would have to hide in the shade, wasting hours of precious time. Similarly, modern chimpanzees stay in shady forests.

In contrast, early humans could keep going because of their ability to "dump the heat" via sweating, says **Tamás Dávid-Barrett** of the University of Oxford in the UK.

"It would be [an] enormous advantage to be able to spend the entire midday foraging, finding mates or fighting enemies," he says. "Sweating allows that, and for sweat to be efficient you need to be mostly hairless. That is the reason why sweating is a useful thing and hence why hair loss is a useful thing."

Our sweaty hairlessness, the theory goes, allowed us to hunt for longer, chasing nutritious large game that eventually helped give us the energy we needed to fuel growing brains.

Patas monkeys sweat a lot too (Credit: Anup Shah/Naturepl.com)

Today, **humans are the sweatiest primates alive**. We have up to five million sweat glands, called eccrine glands. They produce a maximum of **about 12 litres of the stuff per day**, according to estimates made by anthropologist **Nina Jablonski** of Pennsylvania State University in University Park, US.

> *Our upright gait did come in handy when early humans moved into a hotter, more open lifestyle*

While other primates sweat, they do not have such high-density sweat glands, says Jablonski. The few that approach human levels of sweatiness seem to have evolved that way for similar reasons.

For instance, the tropical and fast-running **patas monkey** has lots of eccrine glands. "They almost certainly evolved this relatively high density of sweat glands for the same reason that humans did, to stay cool," says Jablonski. "They did not go as far as we did, however, in losing all body hair."

However, since Wheeler proposed his ideas we have learned that hominins were upright walkers long before they began to inhabit more open environments. Lucy could walk on two legs, but she lived long before climatic changed pushed later species into less forested environments.

This means walking upright may not have been a major contributing factor for hairlessness. The hominins were simply not running all that much yet.

Our ability to run for many hours is thought to be key to our success (Credit: Image Source Plus/Alamy)

However, our upright gait did come in handy when early humans moved into a hotter, more open lifestyle.

Their ability to walk upright and, eventually, run, would have been a considerable advantage, both to hunt prey and avoid predators. At this point, walking upright could drive the loss of more hair, and vice versa.

> *We lost our heavy coat of hair and gained more sweat glands probably at about the same time*

"The less hairy you are, the more advantage you get from being bipedal, and the more time you spend [upright], the more advantage you get from losing hair," says Dávid-Barrett. "These two could have been co-evolving."

The key question, then, may be when hominins began running in earnest. One extinct hominin had the perfect anatomy for running.

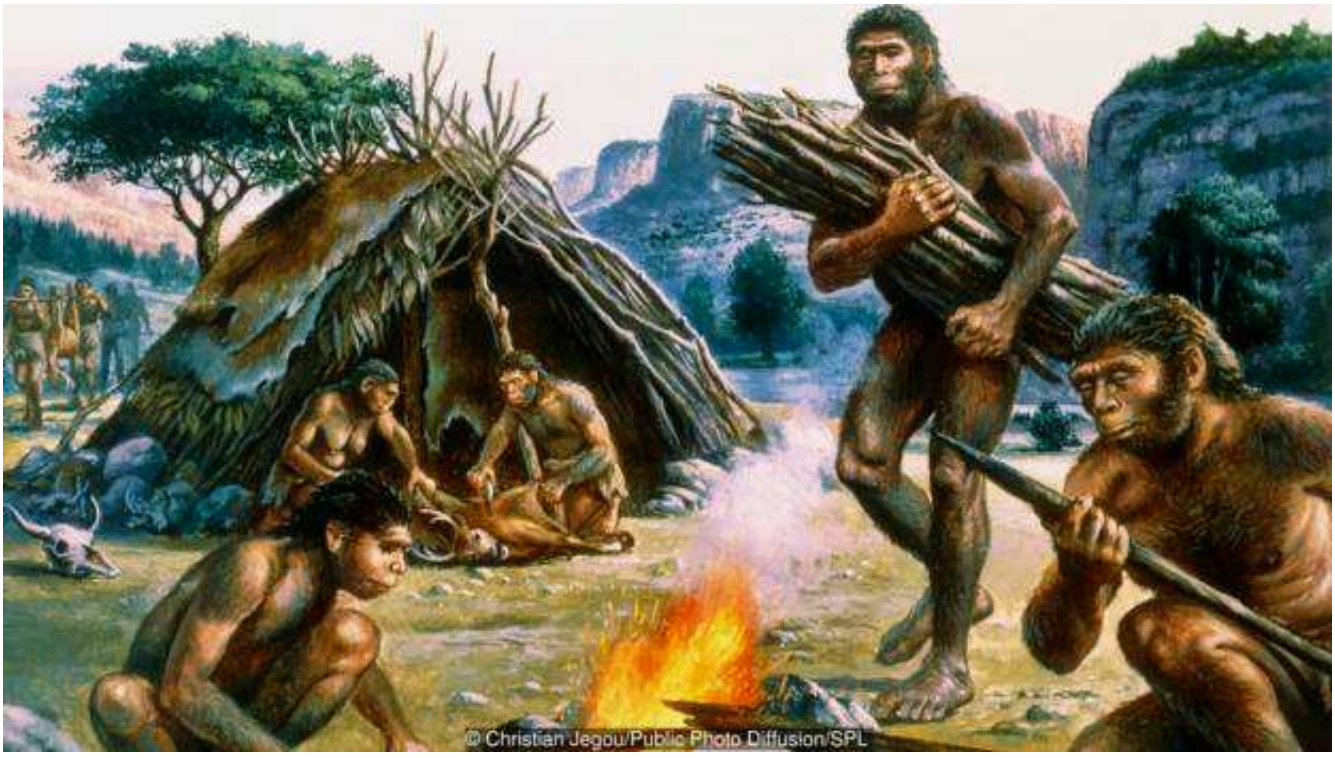
Homo erectus first appeared on Earth about 1.8 million years ago. They stood upright and had larger brains than several of their forebears. *H. erectus* was also the first early human to venture out of Africa, and is believed to be our direct ancestor.

This fits with Jablonski's ideas. "We lost our heavy coat of hair and gained more sweat glands probably at about the same time, during the

course of the early evolution of the genus *Homo*," she says.

Crucially, *H. erectus* had **a body heavily adapted for running**. They had **long Achilles tendons**, which chimps and gorillas do not have, and narrow waists and shoulders – allowing their bodies and heads to rotate independently.

At this point the story starts to look quite neat. However, there has long been a flaw in the sweat-cooling hypothesis that did not sit well with Dávid-Barrett.



Homo erectus might have used fire to keep warm at night (Credit: Christian Jegou/Public Photo Diffusion/SPL)

Wheeler's early models did not account for the fact that hominins had to keep warm at night, when the temperature dropped considerably. Without fur, they would have had little protection from the cold.

Dávid-Barrett and his colleague Robin Dunbar have tried to iron out this wrinkle their ideas were **published in the May 2016 *Journal of Human Evolution***.

They argue that, in order to survive without fur at night, hominins needed to burn many more calories. That means our ancestors needed to fuel their bodies with calorie-rich food during the day.

Dávid-Barrett argues that we could only do this when we started regularly eating cooked food.

Some people are hairier than others (Credit: Cultura Creative/Alamy)

According to a much-discussed hypothesis first put forward by **Richard Wrangham** of Harvard University, hominins began cooking their food as much as two million years ago. Wrangham was trying to explain how hominins acquired such big brains, but his idea could also explain how our ancestors survived cold nights without fur.

Dávid-Barrett points out that, if hominins were cooking food, they must have been using fire. As well as providing them with a better diet, the heat from the fires would have kept them warm at night.

However, this idea only holds up if cooking really is as ancient as Wrangham suggested. There is no archaeological evidence that hominins were using fire two million years ago, and **a study published**

in March 2016 argued that cooking only became common about 500,000 years ago.

Despite these difficulties, the sweating hypothesis remains the leading explanation for why we lost our hair. However, there are other ideas out there.

We should be thankful that we sweat so much when we get hot (Credit: Image Source/Alamy)

One suggestion was that early humans spent much of their time in water, so like walruses and whales they needed hair-free skin to swim effectively. However, this "aquatic ape" idea is largely discredited. If nothing else, plenty of aquatic animals have fur and swim just fine: fur seals and otters are but two examples.

Another idea was that we lost our hair to rid ourselves of parasites. The trouble with this is that does not explain why other primates kept their hair.

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However, over the last 20 years scientists have begun to turn to a new source of evidence:

The assumption is that there is an ocean of bare skin between the two

genetics.

A 2004 study found that a variant of the *MC1R* gene, which is known to be important for darker skin colour, was already present 1.2 million years ago.

This is telling, because naked skin would only get darker after it was repeatedly exposed to heat. The first patches of fur-free skin were probably pink, after which the tropical sun quickly pushed the evolution of dark skin. The presence of the *MC1R* variant suggests that our ancestors were on the path to dark skin, and therefore hairlessness, by 1.2 million years ago.

Futher evidence, this time from lice, backs this up. **A study published in 2004** examined the evolution of the lice that sometimes infest our hair. Different species live in our pubic hair and head hair, and the researchers found that the two diverged 1.18 million years ago.

"The assumption is that there is an ocean of bare skin between the two," says **Dave Wilkinson** of Liverpool John Moores University. So the split in the lice reflects the loss of the hair on our chests. "It's a good a guess as any," he says. These two lineages could also be explained by "direct physical contact between modern and archaic forms of *Homo*," the authors propose.

A big problem for all studies of our hair loss is that the genetic instructions that caused it remain mysterious. Geneticists do not fully understand how our eccrine glands are made.

Losing our fur helped us become the humans we are today (Credit: SPL/Alamy)

They are now getting closer to finding out. In 2015, **by tweaking genes in mice**, scientists showed that the production of sweat glands is closely connected to the production of hair.

The loss of our hair is tied up with our propensity to sweat

"Developmentally, in the embryo, these organs are both derived from the skin," says lead author **Yana Kamberov** of the University of Pennsylvania. "Both are hearing signals from the same source, the skin is deciding which one to make, and they are being made in the same shared space."

Crucially, her team found that sweat and hair gland production are inversely related. When a certain gene was highly active, the mice had more sweat glands than hair, but if the gene was inactive, the mice were hairier and had fewer sweat glands.

The details are still hard to come by. "We don't know when the changes occurred," says Kamberov. "We don't know if humans lost their fur first and then there was an expansion of sweat glands, or whether it was concurrent."

Nevertheless, Kamberov's work suggests that Wheeler was right all along, at least in outline. The loss of our hair is tied up with our propensity to sweat, even at the genetic level – and that in turn is bound up with our ability to run and catch big game, and thus to feed our big

brains.

Now take another look at your strangely hairless friends. It is undoubtedly odd that we are so short of fur. But it seems this is not just an accident of evolution: it is tied up with the evolutionary changes that make us who we are.

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