

# Review of Foodborne Tick-Borne Encephalitis, Europe, 1980–2021

*[Announcer] This program is presented by the Centers for Disease Control and Prevention.*

[Sarah Gregory] Hello, I'm Sarah Gregory, and today I'm talking with Dr. Meital Elbaz, an infectious disease fellow at the Tel Aviv Sourasky Medical Center in Israel. We'll be discussing a review of foodborne tick-borne encephalitis in Europe.

Welcome, Dr. Elbaz.

[Meital Elbaz] Hi, Sarah. I'm very excited to speak here. Thank you for inviting me.

[Sarah Gregory] Well, we're very happy to have you.

So what is tickborne encephalitis?

[Meital Elbaz] Tickborne encephalitis is a viral infectious disease involving the central nervous system. The tickborne encephalitis virus is actually one of the most important human tickborne viral pathogen in Europe and in Asia. The disease that it causes is usually biphasic, with the first stage being the viremic phase. It usually lasts for about five days of the flu-like symptoms, with fever, fatigue, headache, and muscle pain. And after a few days, some patients will develop the second stage, which is the neuroinvasive stage. And here the clinical spectrum of the disease of this stage can range from mild meningitis, which is inflammation of the layers covering the brain, to severe encephalitis, which is inflammation of the brain itself that can cause altered mental status, focal neurological signs, sometimes seizure with or without myelitis, which is inflammation of the spine that can cause limb paralysis.

[Sarah Gregory] So pretty severe illness.

[Meital Elbaz] It can be severe, yes.

[Sarah Gregory] Where is it mostly found?

[Meital Elbaz] As I mentioned earlier, TBE is endemic across Europe and Asia. It's mostly found in the center of Europe, the Baltic region, Russia, and parts of eastern Asia, creating the so-called 'TBE belt', which is the area from France in the west to the most eastern parts of Russia. However, due to mixed socioeconomic-ecological climate factors as well as more susceptible hosts like immunocompromised patients and error-improved diagnostic capability and medical awareness, the epidemiology of TBE is changing. Moreover, because the high volume of foods traveling to endemic areas, imported or travel related TBE is becoming this growing global concern, with more patients diagnosed outside the commonly affected areas.

[Sarah Gregory] And does it have subtypes and where are they found?

[Meital Elbaz] Yes. There are three main subtypes—the European, the Siberian, and the Far Eastern. The vector of the European subtype is seen in most of Europe, and the vector of the other two subtypes (the Siberian and the Far Eastern) is found in the belt extending from eastern Europe to China and Japan.

[Sarah Gregory] Your article is about tickborne encephalitis becoming foodborne as taking that route. What foods carry it?

[Meital Elbaz] Usually, the transmission is from the saliva of an infected tick through tick bites. But it can occasionally be transmitted after the intake of unpasteurized milk and milk products from infected animals like goats, cows, sheep.

[Sarah Gregory] How is this possible? How does this happen? I don't quite understand this.

[Meital Elbaz] Well, the animals are infected, like us, through the tick bite and become viremic but usually they don't experience any symptoms. But during the viremic phase of the infection, the virus is secreted in the milk of this animal. In some studies, the TBE virus was detected repeatedly in the milk of infected goats for about five to 25 days after the animal was infected by the tick. And drinking this raw milk or eating its products can cause human infection, which as I said before, can range from asymptomatic infection to flu-like illness or the more severe neurological diseases.

[Sarah Gregory] I see. So it's the drinking the milk (the raw milk), not from eating the meat.

[Meital Elbaz] That's right. From drinking the raw milk, milk that wasn't pasteurized.

[Sarah Gregory] Is there a seasonality for this?

[Meital Elbaz] Yes. Most cases of TBE in Europe are recorded from the late spring until the first month of Autumn with a peak from May to July.

[Sarah Gregory] And I guess it coincides with tick season?

[Meital Elbaz] Yes, exactly. As I mentioned before, because both TBE from the tick bite and foodborne TBE are still associated with tick bites (the first by bite of the human and the latter by bite of milk-producing cattle), it has the same seasonality. In Europe, the tick activity starts in the Spring when the temperature approaches six degrees and usually persists until November when the temperature falls.

[Sarah Gregory] What's the incubation period from, say, drinking the milk to getting sick?

[Meital Elbaz] The incubation period is actually the time between the infection of a patient by a pathogen to the time the patient starts experiencing symptoms. In the classic TBE, it usually lasts for about eight days but ranges from four to 28 days after the tick bite. In the foodborne TBE, it seems that the incubation period is shorter (something like three days, three and a half days).

[Sarah Gregory] And how common is a resulting neuroinvasive disease from this?

[Meital Elbaz] The European subtype of TBE is thought to be...to cause milder disease than the other two subtypes, with only 20-30% of patients experiencing neuroinvasive disease after the first phase of the illness.

[Sarah Gregory] Is there a vaccination for this?

[Meital Elbaz] Yes, there is. There is a vaccination against TBE virus. The market provides different TBE vaccines containing inactivated strains of the virus, which protects against the European, the Siberian, and the Far Eastern subtype. According to the standard schedule, the vaccines are administered intramuscularly in three doses. It is a very effective vaccine and is recommended for people living in endemic areas. In some countries, it is even a part of the routine childhood vaccination program and for travelers to endemic areas, especially for those who travel for longer periods of time or those who plan hiking, camping, or other outdoor activities in a forested risk area.

[Sarah Gregory] So this is a vaccine for people, not for animals?

[Meital Elbaz] That's right. Only for people.

[Sarah Gregory] What is it called?

[Meital Elbaz] There are many types. There's TICOVAC...many types of vaccines in the market.

[Sarah Gregory] Have there been outbreaks of people getting infected from these foodborne sources? Tell us about some of those.

[Meital Elbaz] Yes, there has been many and mostly small outbreaks, most of them reported from Europe. Slovakia and Czech Republic reported the highest number of foodborne outbreaks, but there are also outbreaks in other parts in Poland, Hungary, Estonia, in Germany...recently from France and other countries in Europe with only a few reports of the foodborne TBE from Russia.

[Sarah Gregory] What were you looking for in your review?

[Meital Elbaz] In spite of being an important mode of transmission (and an easily preventable one), foodborne TBE has not been described systematically to date. Our aim was to review the published literature of foodborne TBE cases in the last four decades and to describe the unique clinical features of this route of transmission. And we also wanted to try and estimate the attack rates for this mode of transmission, meaning how many patients who were exposed to the infected products will eventually develop symptoms.

[Sarah Gregory] What date range did you look at in your review?

[Meital Elbaz] Foodborne cases of TBE goes way back, with the largest known outbreak occurring in 1964 (in what was then Czechoslovakia) when more than 600 people developed TBE via contaminated cow's and goat's milk. We decided to focus on the shorter time period of the last four decades from 1980 to 2021. Ultimately, we included nineteen studies meeting our eligibility criteria and described 410 patients with foodborne TBE.

[Sarah Gregory] Was there a patient age range?

[Meital Elbaz] Well, actually it can occur with any age. We found a very wide range of ages (age distribution), from one year to 25.

[Sarah Gregory] How did you go about doing your review?

[Meital Elbaz] We conducted the systematic review and meta-analysis using the PRISMA guidelines. We searched articles of foodborne TBE published in the last four decades in PubMed and Embase databases and screened all publications and selected those that met our criteria including human data only, English language original articles that all talked about confirmed or probable cases of foodborne tick-borne encephalitis. We defined confirmed case as a person with or without symptoms of infection that had positive laboratory tests supporting TBE infection, with possible link to consumption of raw milk and not recalling tick bite. And the probable cause was defined as person with symptoms compatible with TBE that was not tested for the virus but was exposed to raw milk or cheese as long as there was a cluster of other two cases, at least, of exposed patients with neurological confirmation of tick-borne encephalitis. We reviewed all these articles, extracted data, and then, like number of exposed cases, number of confirmed cases, the laboratory data, the source of infection, the seasonality, the incubation period, vaccination status.

[Sarah Gregory] After all of that, what did you discover?

[Meital Elbaz] As I said before, we found 410 cases of foodborne TBE, most of them from a region in central and eastern Europe stretching from Croatia in the south to Poland and Germany in the north with an anecdotal report of five cases in Russia, creating what we call the foodborne TBE triangle. Most cases were reported during the warmer months from April to August (so the same seasonality as the tickborne cases). We found a short incubation period, as I mentioned before, with 90% of cases appearing less than two weeks from the exposure to infected products.

Even though this transmission mode is different and the incubation period is shorter, the clinical manifestations were similar in patients with foodborne disease. We also found higher rates of central nervous system disease, with almost 40 patients having neurological involvement. It is actually challenging to estimate the actual rate of neuroinvasive disease in TBE since many patients with mild symptoms and no central nervous system involvement are less likely to seek medical care. And even for patients who do, many will be diagnosed with nonspecific viral syndrome. The foodborne outbreaks can actually help determine the actual rate of CNS disease in the epidemiological investigation of patients exposed to a common source and actively locate asymptomatic patients and patients with only mild symptoms.

Also, in our review, none of the infected patients were vaccinated except one patient where their last vaccination booster was more than 15 years prior to infection and was overdue. So we think that the vaccination is effective in the prevention of this mode of transmission and not only the tickborne disease.

[Sarah Gregory] Brucellosis is another disease transmitted by unpasteurized milk. Talk to us a little bit about the number of TBE and brucellosis cases that don't align.

[Meital Elbaz] That's right. But to others who don't know this, it's caused by ingestion of unpasteurized milk, among others. But to our surprise, its geographical distribution is not concordant with the distribution of foodborne TBE. That is, not reflecting the local habits of the raw dairy consumption. We thought about two explanations (possible explanations). One of them is that brucellosis is not transmitted only by raw dairy consumption, but also with undercooked meat and contact with body fluids from farm animals. And then moreover, brucellosis is a preventable disease by national eradication programs and vaccination of the cattle in areas with high prevalence rates. For example, the Czech Republic, as I mentioned before, is one of the leading countries of foodborne TBE yet there are no cases of brucellosis, was probably due to the eradication program of brucellosis from livestock successfully completed in the 60s in the Czech Republic.

[Sarah Gregory] Apparently, there was a recent outbreak in France, an area where TBE virus is not usually found. You mentioned earlier that it is spreading. What happened with that outbreak?

[Meital Elbaz] It's about the more recent reported outbreak, occurring in the Spring of 2020 in Ain in eastern France, where the virus had never been detected before. All patients but one had consumed traditional unpasteurized raw goat cheese from a local producer. And within a month, the epidemiological investigation found 43 patients with encephalitis, meningoencephalitis, or flu-like symptoms. And they confirmed the alimentary transmission by demonstrating the presence of the virus itself in a batch of cheese from this local producer.

[Sarah Gregory] And this is not a country that's normally vaccinated against it, correct?

[Meital Elbaz] That's correct.

[Sarah Gregory] So will they start vaccinating, do you think?

[Meital Elbaz] I don't know about vaccination. Vaccination is not recommended for France or tourists that go there. It doesn't seem necessary at this moment. But there are other ways to avoid tick bites and tickborne disease, and these are recommended to all travelers going to forested areas.

[Sarah Gregory] How common is foodborne transmission of TBE actually and is it really a big health concern?

[Meital Elbaz] We described 410 cases, but this is actually probably just the tip of the iceberg. Although TBE is a reportable disease in many European countries, many cases are not reported by physicians and/or misdiagnosed. And as I said before, most infected individuals experiencing clinical disease suffer only from mild, nonspecific symptoms, leading to underestimation of the real numbers of TBE cases and among them, the foodborne cases. Moreover, approximately up to 50% of patients diagnosed with tick-borne encephalitis do not recall a tick bite, but likely not all of them are asked about consumption of raw dairy, leading to an underestimation of this route of transmission. And even in cases where epidemiological investigations were conducted, many exposed individuals might remain unidentified and untested for the above-mentioned reasons, making the true incidence probably higher than what we think.

[Sarah Gregory] What's the best way for people not to get sick from this? We talked about vaccination obviously, but what else can people do?

[Meital Elbaz] Well, one of the best and simple measures to avoid tick-borne encephalitis infection and other tick-borne diseases is reducing exposure to ticks. This can be done by simple measures like wearing light-colored long-sleeved shirts, pants, socks and shoes when walking in woods and camping, staying on trails and paths to avoid hiking through tall grass or leaf litter where the tick waits and lurks for passing-by mammals to take their next blood meal, to cover your exposed skin with an insect repellent which protects you for several hours. And for people who work in or frequently visit tick-infested areas, they might want to purchase clothing that has been treated with pyrethrin (a non-toxic chemical that kills the ticks). And of course, avoid drinking and eating raw unpasteurized milk and milk products. All of this can reduce the chance to get sick.

[Sarah Gregory] What's your biggest public health fear for the future?

[Meital Elbaz] I think the last three...three and a half years of the pandemic, with more than six million cases of death and long durations of isolation and quarantine probably surpassed my biggest fear for the next future.

[Sarah Gregory] Tell us about your job and what you find most interesting about it.

[Meital Elbaz] I'm an ID fellow in the Tel Aviv Sourasky Medical Center in central Israel. I'm part of the infectious disease team for the last six months, and I have the privilege to work and learn from the most brilliant and very intelligent group of people. I think what I love the most about my job is that it never gets boring, and you never stop to learn. We see patients from all disciplines—medical, surgical, intensive care, immune compromised patients, travelers—and every patient is a puzzle and hopefully most of them we can help to diagnose and treat. So I think helping people is what makes our job most useful and meaningful.

[Sarah Gregory] Thank you so much for taking the time out of your busy day to talk to me today, Dr. Elbaz.

[Meital Elbaz] Thank you very much. Thank you for having me.

[Sarah Gregory] And thanks for joining me out there. You can read the October 2022 article, Systematic Review and Meta-analysis of Foodborne Tick-Borne Encephalitis, Europe, 1980–2021, online at [cdc.gov/eid](https://cdc.gov/eid).

I'm Sarah Gregory for *Emerging Infectious Diseases*.

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