

# Food-dependent exercise-induced anaphylaxis due to potato snacks involving recurring psychogenic abdominal pain

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## Clinical Letter to the Editor

### Food-dependent exercise-induced anaphylaxis due to potato snacks involving recurring psychogenic abdominal pain

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**Running title:** FDEIA from potato snacks

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### Conflicts of Interest

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**To the Editor,**

Food-dependent exercise-induced anaphylaxis (FDEIA) is a distinct type of allergy provoked by ingestion of specific foods and secondary factors such as physical exercise or use of non-steroidal anti-inflammatory drugs. Wheat and crustaceans are the most common causative foods, but reports of fruits and vegetables as causative agents have increased in recent years. However, there are only a few reports of FDEIA due to potatoes.<sup>1–3</sup> Here, we report the case of a patient who experienced FDEIA due to the ingestion of potato snacks and who refused exercise provocation testing due to anxiety. Therefore, his diagnosis was delayed, and he experienced recurrent postprandial abdominal pain due to food anxiety. This study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Institutional Review Board of Fujita Health University (approval number: HM20-204). Written informed consent was obtained from the patients' parents for this study.

This is a case of an 8-year-old boy with a history of bronchial asthma, allergic rhinitis, and atopic dermatitis but no known history of food allergies. He was prescribed a controller for his asthma but was non-compliant with it. Hence, he had several minor cold-associated asthma attacks for a year. The day before he was referred to our hospital, he had ingested natto, rice, potato snacks, and honey bread in the evening, and then played baseball. After he went home and bathed, he experienced abdominal pain, nausea, and cyanosis of the lips; moreover, urticaria appeared on the trunk and lower limbs. He was taken to a hospital, where he was diagnosed with anaphylaxis (An). His symptoms improved with administration of intramuscular adrenaline and antihistamine, and he was discharged after one night of observation. He was then referred to our hospital for the diagnosis and management of An.

First, we prescribed self-injectable adrenaline and instructed the patient to comply with his treatment regimen for bronchial asthma. Based on the absence of crustacean intake before the onset of symptoms, and with wheat also being a common cause of An, we suspected FDEIA due to wheat ingestion as the cause of An. His specific immunoglobulin E (sIgE) titres were measured using ImmunoCAP® (Thermo Fisher Diagnostics, Inc., Tokyo, Japan); however, the assay showed negative results for wheat (0.27 UA/mL) and  $\omega$ -5 gliadin (<0.10 UA/mL); therefore, we did not consider food elimination. He was instead advised to allow a 2-h interval between meals and to perform exercise only when he felt well. Five months after the first episode, he ingested rice crackers, peanuts, and potato snacks; played baseball and tag; ingested potato candy suckers made from soda pop, and then drank carbonated drinks at home. One hour later, he experienced abdominal pain and vomiting; hence, he was taken to a hospital. In the ambulance, he developed urticaria and was given an intramuscular adrenaline injection. Meanwhile, it was revealed that he was also non-compliant to his asthma controller (beclomethasone propionate inhaler and pranlukast) due to a lack of understanding of asthma.

Based on these two episodes, we suspected that the ingestion of potatoes was the cause of An. The test for potato-sIgE returned with a negative result (<0.1 UA/mL), whereas a prick-by-prick test using raw potato showed a positive result (Table 1). Therefore, potatoes were excluded from the patient's diet at school and for 2 h before exercise. After the second episode, he experienced recurring abdominal pain without An and visited our hospital, but there were no noteworthy findings.

Since the diagnosis was difficult, antigen analysis was performed using a previously reported method.<sup>4</sup> IgE immunoblotting using potato protein extract revealed spots of approximately 30 kDa, 50 kDa, 55 kDa, and 60 kDa in the patient's serum (Fig. 1). Based on the results of antigen analysis and the skin prick test (SPT), we determined that the FDEIA involved potato-induced IgE-mediated mechanisms. After sharing the results of the antigen analysis with the patient 11 months after the first episode, his abdominal pain disappeared, and his unscheduled visits ceased. Hence, his abdominal pain was considered to be a psychogenic reaction.

Although potatoes are commonly consumed worldwide, potato-related FDEIA is rare. In this case, the patient had a history of bread consumption prior to the first episode of An, and wheat, which is a well-known cause of FDEIA, was initially suspected to be the cause. However, based on the subsequent association between the patient's diet, his symptoms, and the results of the SPT and antigen analysis, ingestion of potatoes was established as the cause of the food allergy. The positivity rate of sIgE antibodies in FDEIA is approximately 80% and that in SPT is approximately 90%, but there are some cases of negative results for

both wheat and  $\omega$ -5 gliadin sIgE antibodies and wheat SPT in FDEIA caused by wheat in children.<sup>5</sup> Even if the IgE test and SPT returned with negative results, wheat cannot necessarily be ruled out as a cause of FDEIA.

Four potato allergens are currently listed in the World Health Organization/International Union of Immunological Societies (WHO/IUS) database, and two others of approximately 50 kDa have been reported, one of which was adenosyl homocysteinase.<sup>6,7</sup> The IgE-bound proteins in our study were different from these allergens. One of the four proteins detected in this study, enolase, is a known antigen in other foods and may induce allergic symptoms. Other proteins, even those from other species, are not registered in the WHO/IUIS. Therefore, determining the antigens that induced the symptoms in this case is reserved for future investigations.

Several factors may have contributed to the development of this case. In addition to bathing and exercise, the patient's poorly controlled asthma may have triggered his An. Even if the specific IgE test showed negative results, potato-induced FDEIA still cannot be ruled out as the cause of An. Identifying the cause of FDEIA can help to reduce psychogenic reactions. Hence, SPT and antigen analysis, as well as serum IgE assays, are useful in the identification of the causative food of An.

### Keywords:

anaphylaxis, food hypersensitivity, exercise-induced allergies, skin test, antigens, *Solanum tuberosum*

### Signature

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**Atsushi Inagaki, Yuki Nishikawa:** Validation

**Mariko Shimizu:** Investigation, Validation

**Chiharu Kawaguchi:** Supervision, Validation, Writing – review & editing

**Nayu Sato, Tomofumi Kawabe:** Data curation, Formal analysis, Methodology, Software, Validation, Visualisation

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## Impact statement

We report an unusual case of potato-induced FDEIA in a child presenting with recurrent abdominal pain, which was deemed psychogenic. Our report highlights the importance of identifying the cause of FDEIA to control its associated psychogenic symptoms. Even if the specific IgE test showed negative results, potato-induced FDEIA still cannot be ruled out as the cause of An. Hence, SPT and antigen analysis, as well as serum IgE assays, are useful in the identification of the causative food of An.

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## Figure legend

Figure 1. Results of two-dimensional (2D) immunoblotting and protein identification using mass spectrometry. (A) Potato protein was analysed using 2D Poly-Acrylamide Gel Electrophoresis (PAGE). (B) Immunoblotting shows proteins bound to IgE antibodies in the serum from the patient and healthy controls. The white lines indicate spots specific to this case. These proteins were identified by mass spectrometry. (C) The proteins were identified by mass spectrometric analysis using the National Centre for Biotechnology Information database (<https://www.ncbi.nlm.nih.gov/>) (*Solanum tuberosum* ).

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