Potatoes and new type 2 diabetes risk

Higher intake of French fries, but not baked, boiled or mashed potatoes, was associated with an increased risk of developing type 2 diabetes according to this prospective cohort study published in the *BMJ*. The study used individual patient data from more than 200 000 men and women, without cardiovascular disease, type 2 diabetes or cancer at baseline, who completed regular food frequency questionnaires in the Nurses' Health Study, Nurses' Health Study II and the Health Professionals Follow Up Study. Over a follow-up of more than 5 million person-years, 22 299 people developed type 2 diabetes. After adjustment for BMI and other diabetes risk factors, higher potato intake was associated with increased risk of type 2 diabetes, largely driven by higher intake of French fries, with no increase associated with other potato types combined. Every three extra servings of French fries per week was associated with a 20% higher risk of developing new type 2 diabetes. Replacing potato intake, especially French fries, with whole grains reduced this risk, whereas replacing with white rice increased the risk. An accompanying dose–response meta-analysis of prospective cohort studies confirmed these findings, improving the robustness of the associations.

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The association between consumption of potatoes in their various cooking preparations and the risk of developing type 2 diabetes remains unclear but is important since potatoes are a staple vegetable and a source of cheap calories in most households. Potatoes contain fibre, vitamin C, potassium, magnesium and polyphenols; however, they have a high glycaemic index and, therefore, are generally perceived as less healthy than other vegetables.

Some previous studies have suggested that potato consumption increases the risk of developing type 2 diabetes, while others have not. The Danish Diet, Cancer and Health Cohort study identified 7695 new cases of type 2 diabetes during 16.3 years of follow-up but did not find any significant association between fried potato intake and type 2 diabetes risk after multivariate adjustments (Pokharel et al, 2023). Conversely, a UK Biobank study following 174 665 people for 11.4 years found a 30% higher incidence of type 2 diabetes in those consuming more than two servings of potatoes per day (Wan et al, 2023).

A previous study by the current author group from Harvard demonstrated a positive association between high potato intake, and especially high French fries intake, and an increased incidence of type 2 diabetes (Muraki et al, 2016). The present updated study builds on the previous one by including an additional 7000 cases of new-onset type 2 diabetes from the same cohorts; therefore, it was anticipated this would further clarify the association between potato consumption and new type 2 diabetes.

The study

In this large, prospective cohort study published in the *BMJ*, Mousavi and colleagues investigated the association between potato intake and risk of developing type 2 diabetes, as well as the impact of replacing potatoes with whole grains and other sources of carbohydrates.

Individual participant data were analysed from 205 107 men and women, without type 2 diabetes, cardiovascular disease or cancer at baseline, who were enrolled in the Nurses' Health Study, Nurses' Health Study II and the Health Professionals Follow-Up Study in the US. A dose–response meta-analysis using the study data along with data from 12 other cohort studies was also undertaken.

Participants had completed validated, semi-quantitative food frequency questionnaires (FFQs) at baseline and updated questionnaires

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approximately every 4 years thereafter, improving data available compared to studies with baseline FFQs only. Potatoes listed in the FFQs included boiled, mashed and baked potatoes combined and French fries, and the impact of French fries versus non-fried potatoes on type 2 diabetes risk was evaluated. Potato crisps were not included within potato intake, as potato and corn chips (crisps) were combined in the FFQs used; these were considered separately.

Results

New type 2 diabetes was diagnosed in 22 299 participants over more than 5 million person-years of follow-up in the study. After adjustments for BMI and other type 2 diabetes risk factors, higher intake of potatoes was associated with an increased risk of type 2 diabetes, and this was largely driven by increased consumption of French fries rather than other types of potatoes.

It is important to be aware that this was a cohort study, and those who had higher potato intake also had higher consumption of red meat, eggs, dairy, legumes, starchy vegetables, refined grains and sugar-sweetened drinks, and generally lower diet quality and higher total energy intake, as well as tending to be less active and less likely to take supplements.

After adjustment for BMI and other lifestyle factors related to development of type 2 diabetes:

- Those eating more than seven portions of any type of potatoes per week had a 12% higher risk of new type 2 diabetes than those eating less than one portion per week.
- Five or more portions of French fries per week versus virtually no French fries was associated with a 27% increased risk of incident type 2 diabetes.
- Every increment of three servings of all types of potatoes per week was associated with a 5% increased risk (hazard ratio 1.05, 95% CI 1.02–1.06) of developing type 2 diabetes, whereas each three extra servings of French fries was associated with a 20% increased risk (hazard ratio 1.20, 95% CI 1.12–1.28).
- There was no significant association between intake of combined boiled, mashed or baked potatoes, or of corn and potato chips, and new type 2 diabetes risk.
- In the meta-analysis of 13 pooled studies, with more than 43 471 new type 2 diabetes diagnoses, each increment of three portions per week of potatoes overall increased the hazard ratio of new type 2 diabetes by 3%, and each increment of three portions of French fries increased risk by 16%, confirming the original study results.

Modelling was used to explore substitution analyses, showing that replacing any type of potatoes with whole grains was associated with a reduced risk of type 2 diabetes, with the greatest impact from replacing French fries:

- Replacing three servings of potatoes (any type) weekly with whole grains reduced type 2 diabetes risk by around 8%.
  - ➤ Replacing three servings of boiled, mashed or baked potato with whole grains reduced the risk of type 2 diabetes by 4%.
  - ➤ Replacing three servings of French fries with whole grains reduced type 2 diabetes risk by 19%.
- Replacing total potatoes or boiled, mashed and baked potatoes with white rice was associated with a higher risk of type 2 diabetes.
- Replacing French fries with legumes, starchy or non-starchy vegetables, or even refined grains, was estimated to lower the risk of type 2 diabetes.
- In substitution meta-analyses, replacing three servings per week of potatoes overall, non-fried potatoes and fried potatoes with three servings of whole grains decreased new type 2 diabetes risk by 7%, 5% and 17%, respectively, confirming findings of the cohort study.

Postulating on the potential mechanisms, the authors conclude that eating large amounts of potatoes, a high-glycaemic-index food, could cause blood glucose spikes, resulting in higher insulin levels and potentially resulting in damage to or dysfunction of pancreatic beta-cells, eventually leading to insulin resistance, beta-cell failure and type 2 diabetes. However, they conclude that this is unlikely to be the full explanation.

Deep-frying potatoes to make French fries results in advanced glycation end-products and production of heterocyclic amines, which are known to be bad for health. Over the course

of the study, the beef fat used for cooking French fries was gradually replaced by partially hydrogenated oils (high in trans-fats) and, when these were effectively banned, other types of vegetable oils. Most people use ultra-processed French fries rather than preparing fries from potatoes, and ultra-processed foods are known to be associated with increased risk of type 2 diabetes (Chen et al, 2023; see previous *Diabetes Distilled*).

In an accompanying editorial, Ibsen and Zhang (2025) highlight that the strengths of this study include the large cohorts with 30 years of repeated dietary assessments, the high numbers of new type 2 diabetes diagnoses and the combining of the results with those of previous studies in the meta-analyses. Limitations include those of any observational study (i.e. that results may be impacted by unidentified confounders) and the fact that the participants were all healthcare professionals, with a limited mix of ethnicities. The substitution analyses relied on statistical modelling rather than actual dietary replacements, and substitution of potatoes with foods other than whole grains, such as sweet potatoes, was not included and would have been useful.

Ibsen and Zhang highlight that potatoes could be considered an environmentally sustainable source of carbohydrates since, compared with rice, growing potatoes results in lower carbon dioxide emissions, acidification of soil and accumulation of nutrients in rivers and lakes (potentially reducing algal growth), as well as requiring less use of fresh water.

Implications for practice

People often ask us about what to eat for the prevention and management of different health conditions, including type 2 diabetes. With time constraints and lack of nutrition training, it can be useful for us to have one or two clear messages which are easy to share.

Since most people's diets include a high proportion of ultra-processed foods, suggesting an addition of one or two "real" foods each week should be an achievable and sustainable step. For example, as this study suggests, replacing one or two portions of ultra-processed French fries with boiled or baked potatoes or whole grains each week may be beneficial, and specifically may reduce risk of developing type 2 diabetes. Secondly, we can remind people that the same eating patterns and dietary changes can benefit most health conditions, whether they want to lose weight or reduce their risk of heart attack, type 2 diabetes or stroke, so only one set of changes is needed and these can implemented gradually.

This study demonstrated that replacing any kind of potatoes with white rice was associated with an increased risk of type 2 diabetes, so advice to those whose diets are rice-based can include guidance on reducing rice portion size and increasing vegetable components of the meal, as well as sequencing; that is, eating fibre- and protein-rich components of the meal first before eating rice, aiming to reduce glucose spikes.

Once again, just a few words from us may motivate people to make healthier choices, one food at a time. Let's help people change!

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Total and specific potato intake and risk of type 2 diabetes: Results from three US cohort studies and a substitution meta-analysis of prospective cohorts

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Practice points

1. French fries, but not other types of potato, including boiled, mashed and baked, are associated with increased risk of developing type 2 diabetes.
2. Swapping out French fries (especially if ultra-processed) for "real" mashed, baked or boiled potatoes, or whole grains, reduces the risk; however, replacing with white rice further increases the risk.
3. Replacing ultra-processed foods with one or two "real" foods each week should be an achievable and sustainable step to improve health.