

## What do the latest studies say about IARC's lone conclusion that glyphosate could cause cancer? Faulty memories, statistical bias undermine conclusion

Glyphosate is a broad-spectrum herbicide that is used to control many types of plants worldwide. The International Agency for Research on Cancer in 2015 concluded that there was limited evidence in humans for the carcinogenicity of glyphosate, but sufficient in animals, and particularly noted positive associations with non-Hodgkin lymphoma (NHL) in humans. Since the IARC determination other agencies have not concurred with IARC's conclusion (European Food Safety Authority, 2015; World Health Organization, 2016; US Environmental Protection Agency, 2019). Whether or not glyphosate presents a rerisk of NHL remains controversial. . The principal human data on glyphosate and NHL come from five case-control studies and two cohort studies.

The principle human evidence regarding a link between glyphosate exposure and NHL is contained in five case-controlled studies and two cohort studies, both of which are based on a cohort defined in the Agricultural Health Study. In each of the case-controlled studies, the evidence on the extensive of pesticide exposure comes from self-reporting by both cases and controls.

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The case-control studies are at risk of recall bias resulting from information on exposure to pesticides being collected from cases and controls based on their memories. In addition, two of the case-control studies are additionally at risk of a form of selection bias that can exacerbate the effect of recall bias. Both biases are in the direction of making glyphosate appear carcinogenic.

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This article provides evidence that at least four of the five case-control studies of glyphosate exposure and NHL are contaminated by statistical bias, likely stemming in the main from recall bias, exacerbated by selection bias in two of the studies. This suggests that the case control suites of glyphosate are not reliable for determining whether glyphosate is carcinogenic. However, the two cohort studies do not present evidence of bias. ... Of course, cohort studies have other potential problems that must be evaluated, including incomplete follow-up, the healthy worker effect and/or information on exposures.

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[In addition, a] recently completed ... thorough reanalysis of data from ten rodent bioassays, which included all the animal studies IARC considered to provide evidence of carcinogenicity of glyphosate ... found no strong evidence that glyphosate is an animal carcinogen.

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