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Statistics improve insight into the risks of nanoparticles

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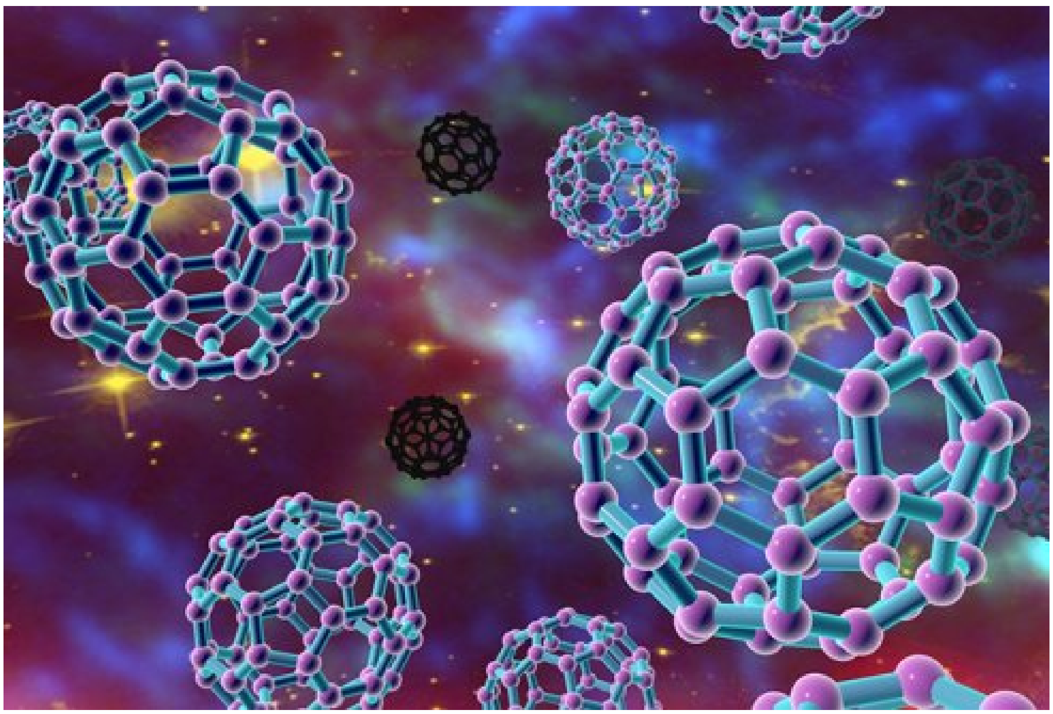

Credit: Wageningen University

By using specific statistical methods, it has become possible to improve the risk assessment of nanoparticles. This was the conclusion of the PhD thesis that Rianne Jacobs defended on 7 July 2016 at Wageningen University. Jacobs showed that these techniques can be used in risk assessment to separate two important sources of error, which makes the results of the assessment more reliable.

Nanotechnology is a relatively new, but fast growing field. As with all novel materials, nanoparticles have no history of safe use. This makes it difficult to assess the risks. To create broad societal support for nanotechnology, it is essential to understand the risks. Important questions in this respect are the following: with limited experience, how can the risks be estimated as accurately as possible, and how can we quickly acquire more understanding of these risks? With her research, Jacobs wants to help answer questions like these.

Lack of knowledge and small sample sizes

There are two important reasons why it is difficult to assess the risk of nanoparticles. The first reason is the lack of knowledge: how do the particles become dispersed in the environment, how do people and other organisms come into contact with the particles and how harmful are they for these organisms? This lack of knowledge leads to uncertainty in the risk assessment. The second reason is that risk assessors often have to work with small sample sizes. This results in a large margin of error in the risk assessment. In her study, Jacobs has shown how statistical methods can help risk assessors deal with this uncertainty and these small sample sizes.

Uncertainty and variability

When estimating risk, researchers focus on measurements, but such measurements are never conclusive. Statistical techniques can help describe the variation in the measurements. An important consideration is that there are two separate effects: uncertainty and variability. Uncertainty results from a lack of knowledge, for example because researchers have not made enough measurements or they have not made them with sufficient accuracy. This can obviously be improved. Variability is the variation that is inherent to all natural processes and living organisms. For example, humans react differently to many substances than yeast cells do. This variation is a fact of nature; you cannot do anything to 'improve' it.

Integrated Probabilistic Risk Assessment

Jacobs successfully used the method known as Integrated Probabilistic Risk Assessment (IPRA) to separate these two types of variation. This method was developed to assess the health effects of chemicals on people, but Jacobs has adapted it to nanoparticles. With this method, risk assessors not only achieve a better result than with standard worst-case estimates, the method also identifies which sources of uncertainty contribute the most to the total uncertainty in the risk assessment. By focussing on these sources, the risk assessment can be improved substantially.

Examples from practice

In her investigation, Jacobs studied various applications of nanoparticles, such as nanosilica in food products, titanium dioxide in cosmetics and medicines and antibacterial silver particles. With her approach, Jacobs was able to identify the most important sources of uncertainty in these applications. Based on this identification, research can focus on the most crucial areas, which leads to substantial progress in reducing the uncertainty that currently hampers the risk assessment of nanoparticles.

Provided by Wageningen University

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