

Health risks associated with livestock farms: follow-up advice

To: the Minister of Agriculture, Nature and Food Quality
the Minister of Health, Welfare and Sport
the State Secretary for Infrastructure and Water Management
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Health Council of the Netherlands



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01 introduction

1.1 Background

There has been growing concern for many years about the health risks of living near livestock farms. Against this background, the ministers of VWS (Health, Welfare and Sport) and LNV (Agriculture, Nature and Food Quality) at the time decided to have a broad study performed, the Intensive Livestock Farming and Health study (Dutch: IVG).¹ After that, the Health Council of the Netherlands was asked to assess the results of this study, considering the usefulness and necessity of adopting minimum distances between residential areas and livestock farms.² In the Council's judgment, the available scientific data had limited evidential strength and did not allow conclusions to be drawn about what distance posed elevated health risks to residents living near livestock farms. Further research would provide more clarity. The cabinet at the time announced that it would free up resources for the recommended study.³ This follow-up study on Livestock Farming and Risks for Local Residents (Dutch: VGO) has now resulted in two reports in 2016 and 2017, plus various publications in scientific journals.^{4,5}

1.2 New request for advice and method of working

Following the VGO study, the State Secretary for Economic Affairs at the time presented a new [request](#) for advice about livestock farms to the Health Council of the Netherlands, on behalf of the State Secretary for

Infrastructure and the Environment (IenM) and the Minister of VWS at the time as well. The key question is how strong the indications for health risks near livestock farms are in the light of the latest data. Furthermore, a number of specific questions are asked about ammonia as a source of secondary particulate matter, about risk-reducing measures, about the risk of cardiovascular diseases and about the desirability of follow-up research.

A group of experts was consulted to answer this request for advice (see the appendix). For issues relating to the health risks of air pollution – on request of the government too – the recently published advisory report [Health benefits through cleaner air](#) was accepted as a starting point.⁶ The system of evidential strength that the Air Quality Committee used, has also been followed in this advisory report on livestock farming. The report [was presented](#) to the government on 14 February 2018.

Levels of evidential strength: various terms are used, but the meaning is the same

One commonly used system for assessing health risks caused by air pollution has been developed by the American EPA (Environmental Protection Agency). A distinction is made between increasing levels of evidential strength for causality, depending on the quantity and quality of the scientific information available. The Air Quality Committee has used



this system and defined the health effects for which it has been proven or is probable that they are caused by air pollution.^{6,7}

In the request for advice, the State Secretary makes a distinction between ‘generally accepted insights’ and ‘indications’. To stay in line with the approach used by the Air Quality Committee, ‘generally accepted insights’ are taken to mean proven or probable causal links, and ‘indications’ are possible causal links for which the evidential strength falls short.

1.3 Reading guide

An outline of the observations from the VGO study is given first. A comparison is made at that point with what the preceding IVG study showed. Data from foreign studies about health risks near livestock farms is then discussed, as is the state of knowledge of livestock-related components of air pollution. An overall assessment is then given based on all that information, and the desirability of follow-up research and the focal points for risk reduction are discussed. Finally, the advisory questions are answered.

02 new knowledge since 2012

2.1 VGO: further observations about pneumonia

Like the IVG study, the VGO study only focuses on areas in Brabant and Limburg with intensive livestock farming. However, the empirical basis is significantly broader: besides data from GPs (110,000 patients) there are

now also a questionnaire survey (12,000 people) and medical examinations (2,500 people). A few follow-up studies have also been performed and extensive air quality measurements have been carried out.

The bulk of the results of the VGO study^{4,5} confirms the results of the IVG study. The overall picture is once again ambiguous. Asthma, allergies and COPD for example appear to be less common near livestock farms. On the other hand, complications appear to be more common in COPD patients who live near livestock farms. Furthermore, there are indications that local residents do have decreased lung function. This effect has been found in particular in people who live within a radius of one kilometre of 15 or more livestock farms, and on days with higher ammonia concentrations in the entire study area. The researchers consider this observation, in terms of the size of the effect, to be comparable to decreased lung function resulting from air pollution caused by urban traffic. Studies into infectious diseases that can be transferred from animals to humans (zoonoses) and into resistant microorganisms among local residents yielded no indications in most cases for linkage to livestock farms.

It was already known that there was an elevated risk of pneumonia in the vicinity of poultry farms (within a radius of over 1 km). This finding was made back in 2009, based on information from GPs for that year. The VGO research, based on further information from GPs, confirms that picture. A new element is that a link has also been found between the



incidence of pneumonia and the proximity to goat farms (within a radius of 1.5 to 2 km). The elevated level of risk cannot be explained by Q fever, because the association was also found in the years after the outbreak. Of all the pneumonia cases in the area studied, 7.2% (119 patients per 100,000 people) are associated with goat farms and 5.4% (89 patients per 100,000 people) with poultry farms.

2.2 The international perspective

The Health Council of the Netherlands noted in 2012 that little research had been done, from an international perspective, into the health of local residents near livestock farms, certainly when compared to the copious and rapidly growing body of literature about urban air pollution. Even less research, said the Council, was good quality work.²

Three articles have appeared since then about the state of knowledge internationally: Casey et al. in 2015, O'Connor et al. in 2017, and Douglas et al. in 2017 as well.⁸⁻¹⁰ The amount of new data is limited and the size and methods of the available studies are highly heterogeneous. That continues to complicate the interpretation of the results and provides scope for different selections and interpretations of the data, as the review articles in question show. In addition, the research group of Casey et al. is critical of the method adopted by Connor et al.¹¹ The criticism focuses above all on the application of tools from the clinical domain to assess the quality of evidence and the risk of bias in the outcomes. These tools are

not deemed sufficiently usable for an assessment of the quality of environmental epidemiological studies into the health risks in the vicinity of livestock farms. Too much of the data, including the results of ecological studies, would have been excluded by the application of any such instruments.

As a consequence, the conclusions in the review articles differ to some degree. Based on 16 studies, Connor et al. state that there are no consistent indications for the existence of relationships between health effects and the proximity of livestock farms.⁹ Casey et al. conclude on the basis of 33 studies that they do show indications of, inter alia, effects on the respiratory tract.⁸ Douglas et al. draw a similar conclusion based on 38 studies (21 among livestock farmers, 17 among local residents).¹⁰ There is consensus on two points: firstly, that outbreaks of Q fever present a clear health risk for which the causal nature has been demonstrated, and secondly that more robust evidence is needed, based on larger and longer term prospective studies and with a more extensive analysis of the possible mechanisms.

2.3 Components of air pollution around livestock farms

Knowledge of the health risks of exposure to components of the air around livestock farms can also help in the risk assessment. Attention thus far has largely focused on particulate matter, endotoxins (components of bacterial cell walls) and certain microorganisms.²



Particulate matter

A great deal is now known about the effects on health of exposure to particulate matter. There are effects on the heart and blood vessels and on the respiratory tract, from both short-term and long-term exposure. There are no indications of a threshold value below which there are no effects. The evidence for the causal relationship is in the highest categories (proven or probable). The advice from the Air Quality Committee goes into considerable detail.⁶ There are also increasing indications that all particulate fractions are harmful, including the coarser fraction (PM_{2.5-10}) in the vicinity of livestock farms.¹² The spectrum of health effects can however differ from what is seen in urban surroundings, because of the higher concentrations of endotoxins and microorganisms (bacteria, parasites, fungi and viruses) in the cocktail of particles found around livestock farms. More precise statements are however not yet possible, given the current state of knowledge.

Endotoxins

Since 2012, when the Health Council of the Netherlands proposed a health-based recommended exposure limit of 30 EU/m³ (endotoxin units per cubic metre of air), an initial exploration suggests that no data has become available that offers further information about the health risks of exposure to endotoxins. A number of Dutch reports have appeared about emissions of endotoxins by livestock farms and about measures for reducing emissions.^{23,24} The present request for advice refers to current

studies that can be used as the basis for drawing up an assessment framework for endotoxins. The government intends in due course to submit a separate request for advice to the Health Council of the Netherlands about this topic.

Microorganisms

There is in general little known about the exposure-effect or exposure-response relationships for microorganisms, according to the previous advice given by the Health Council of the Netherlands. That is still the case.¹³

03 assessment and follow-up

3.1 Data assessed integrally

As the authors of the VGO reports have noted, it is not possible to determine purely on the basis of the VGO research whether the associations found between the air quality and the health effects around livestock farms are causal in nature. They have also pointed out that the data applies to a research area with specific characteristics, such as background air pollution, the number and types of livestock farms, the micro-organisms present in them and characteristics of the population. The results can therefore not always be simply translated to other areas in the Netherlands or elsewhere. At the same time, there are consistent findings over a lengthier period of time that are based on multiple data



sources. In that sense, the evidence for the associations that have been found has become clearer.

Can further conclusions be drawn if international research into health risks around livestock farms is included in the considerations?⁸⁻¹¹ From the international perspective, there are indeed also indications that living in the vicinity of livestock farms can have effects on the respiratory tract, in particular decreased pulmonary function and an elevated prevalence of respiratory tract problems. As early as 2012, the Health Council of the Netherlands pointed to German research with a design that was similar to the VGO study.^{2,14} The observation that decreased pulmonary function was observed on days with higher ammonia concentrations was noted in an American study among asthmatic children as well.¹⁵ The number of international studies is however limited and the evidential strength of the available research often leaves a lot to be desired, certainly when compared to the much larger-scale and methodologically well executed studies into urban air pollution. Translating the outcomes of foreign livestock farming research to the Dutch situation is not straightforward either. Taken as a whole, the number of good-quality studies is limited and it is not sufficiently clear whether the associations that have been found are causal in nature. One reason for this is the exposure variables involved. These have mostly used geographical information (distance to livestock farms, density of livestock farms around houses) instead of concentrations of specific components in the air.

Does knowledge about the air pollution components in the area surrounding livestock farms provide a better starting point? As the Air Quality Committee has explained, a causal relationship between negative effects on the respiratory tract and exposure to particulate matter is probable.⁶ If concentrations are higher in the vicinity of livestock farms than in rural areas without livestock farms, more effects on the respiratory tract would therefore be expected. A couple of comments are needed here. It is unclear to what extent other components from livestock farms could be having an effect, such as endotoxins, microorganisms and ammonia. The VGO researchers noted that the ammonia itself is probably not the causative factor in the link between an elevated concentration of ammonia and a decreased pulmonary function. This may possibly be caused by what is referred to as 'secondary particulate matter', fine dust particles created when ammonia reacts with other substances in the air.

The Air Quality Committee has considered this latter question. Secondary particulate matter is only formed after a certain time and will by then have already spread over greater distances. According to the Committee, it would not be expected that concentrations of secondary particulate matter should be higher at a very local scale around livestock farms than at greater distances. The Committee therefore deems it unlikely that the health risks resulting from exposure to secondary particulate matter are higher for residents near livestock farms than for people living further away.⁶



In the case of the elevated risk of pneumonia, the researchers have suggested that breathing in the air around livestock farms could lead to a change in the oropharyngeal composition of the bacterial population (known as the ‘microbiome’).¹⁶ This is thought to make local residents more susceptible to infections or to respond differently to infections. This study did not look at microorganisms. There have however been studies into urban air pollution in which an elevated risk of pneumonia was found.¹⁷⁻¹⁹

3.2 Follow-up study: current activities and new themes

The VGO study has yielded numerous new insights, but there are still questions open and new ones have arisen. Follow-up studies would therefore seem sensible. Two research themes are already being focused upon. Firstly, there is the current research into an assessment framework for endotoxins.^{23,24} As stated, the government intends to ask the Health Council of the Netherlands about the results of this. Secondly, research will be carried out into the risk of pneumonia in the vicinity of goat farms. It is recommended that additional research should be done into possible mechanisms for the occurrence of pneumonia around livestock farms.²⁰⁻²² Together, these two lines of research will cast more light on the causal nature of the relationships in the various findings.

Is it worthwhile to look at other possible health effects as well, in particular cardiovascular disease and lung cancer? The request for advice notes that those effects might also have a relationship with particulate matter from livestock farms. The Air Quality Committee explains in its advice that a great deal is known in this regard about the harmful effects of particulate matter.⁶ No further research is required from a health point of view to underpin the air quality policy.

3.3 What measures are sensible?

Further reductions in emissions of particulate matter (including all living and dead organic material) are important, as are ammonia reductions. The levels of reductions that need to be aimed for here are a political consideration, as the Air Quality Committee also notes in a broader context.⁶ It is in any event sensible to monitor whether reduced exposure to the relevant components of air pollution around livestock farms also yields any health benefits.

In the judgement of the experts who were consulted, there are still important points that the Health Council mentioned back in 2012.² Living in proximity to livestock farms involves more than just health risks in the restricted sense of the term. Well-being and how pleasant the area is to live in play a major role too. Risk perception is an issue as well. In that light, policy should for example also focus on limiting odour nuisance and



on better observance of the existing regulations in that regard. Ongoing attention is also required for new forms of business operations and farm hygiene. This will benefit not only local residents but also employees in the livestock farming sector. On top of that, it will also benefit animal welfare.

04 answering the request for advice

What insights are scientifically generally accepted and for which risks is it more a question of indications?

All the associations found in the VGO study and in international research into health risks around livestock farms are indications, of varying degrees of strength. The available data is too limited to be able to speak of ‘generally accepted insights’.

What is known about the health risks of exposure to secondary particulate matter, about livestock farming as a source of secondary particulate matter and about risk mitigation measures? Are additional studies on this topic worth carrying out and, if so, which studies should be given priority?

The Air Quality Committee has written the following on this subject in Section 4.5 of its advisory report ‘Health benefits through cleaner air’.⁶

“The emission of ammonia from livestock farms contributes to the formation of secondary particulate matter (ammonium salts) and therefore makes an important contribution to the total concentration of particulate matter in the Netherlands and neighbouring countries. As it takes quite some time for secondary particulate matter to be formed and it has by then spread over large distances, the concentrations of secondary particulate matter on a very local scale, in the immediate vicinity of livestock farms, are not expected to be significantly higher than in locations further away. It is therefore not likely that the health risks related to secondary particulate matter differ significantly between local residents living near livestock farms and persons living further away. The Committee advocates research projects that focus on tracking down the specific source of emissions and that improve our knowledge of the formation of secondary particulate matter. As it turns out, none of the Dutch or international models can fully explain the origin of the concentrations of particulate matter measured.”

What is known about the health risks regarding cardiovascular disease and lung cancer in the vicinity of livestock farms? Is follow-up research in this field sensible and if so, what research would be recommended?

No research has been done into the risk of cardiovascular disease and lung cancer around livestock farms. That risk has however been examined in depth in urban environments. As the Air Quality Committee explains, these health effects are a definite or highly probable consequence of exposure to particulate matter. That is why it advises tackling emissions that create the ‘blanket’ of particulate matter above the Netherlands at the source.⁶ The agricultural sector is one of those sources. Follow-up research is not required in order to underpin that policy.



literature

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annex



A experts who were consulted

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