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Vertaisarvioinnissa hyväksytty 3.3.2025  
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**Ruska Rimhanen-Finne ja Janne Lunden**

**Experiences and perceptions among health and environmental health authorities on the probability of food terrorism and food defence in Finland**

**Ruokaterroismin todennäköisyys ja elintarvikkeiden suojaaminen Suomessa – terveydenhuollon ja ympäristöterveydenhuollon ammattilaisten näkemyksiä ja kokemuksia**

**Erfarenheter och synpunkter bland hälsovårds- och miljöhälsoskyddsmyndigheter om sannolikheten för livsmedelsterrorism och livsmedelsförsvar i Finland**

**SUMMARY**

Food terrorism is an act or threat of deliberate contamination of food or drinking water with chemical, biological, radionuclear (CBRN) or physical agents. We studied experiences and perceptions of local and regional health and environmental health authorities on the probability of food terrorism and their preparedness to investigate such incidents. The respondents (n=54) represented 90% (19/21) of Finland's wellbeing services counties. Most respondents (89%) considered the same detection and response systems to be used in outbreak investigations irrespective of whether the event was intentional or unintentional. The most likely health threats considered were adding pathogens to food served to a crowd (74%) and affecting military operational capacity with pathogens added to water or food (74%). The authorities delineated that the possibility of deliberate adulteration of food and drinking water would increase over the next 10 years. According to the respondents, 28% of the operation areas contingency plans did not include instructions on how to respond to food terrorism. The national food and water safety authorities should ensure that guidelines exist for the prevention of food terrorism and that potential targets, such as food business operators and water suppliers, are aware of the risks and protected.

**YHTEENVETO**

Ruokaterroismi on tahallinen teko tai uhkaus ruuan tai juomaveden tahallisesta saastuttamisesta kemiallisilla, biologisilla, fyysisillä tai radioaktiivisilla aineilla. Selvitimme paikallisten ja alueellisten terveydenhuollon ja ympäristöterveydenhuollon viranomaisten kokemuksia ja näkemyksiä ruokaterroismin todennäköisyydestä ja valmiudesta selvittää tapauksia. Vastaajat (n=54) edustivat 90 %:a (19/21) Suomen hyvinvointialueista. Suurin osa vastaajista (89 %) oli sitä mieltä, että samoja havaitsemis- ja reagointijärjestelmiä käytetään epidemiaselvityksissä riippumatta siitä, onko epidemia aiheutettu tahallisesti vai tahattomasti. Todennäköisimpiä arvioituja terveystuhkia olivat taudinaiheuttajien lisääminen

suurelle väkijoukolle tarjoihtuun ruokaan (74 %) ja puolustusvoimien saattaminen toimintakyvyttömäksi lisäämällä taudinaiheuttajia veteen tai ruokaan (74 %). Viranomaiset arvioivat, että todennäköisyys ruuan ja juomaveden tahalliseen saastuttamiseen lisääntyy seuraavan 10 vuoden aikana. Ohjeita ruokaterorismin varautumisesta ei annettu 28 %:lla vastaajien toiminta-alueiden valmiussuunnitelmista. Ympäristöterveydenhuollosta vastaavien viranomaisten tulee varmistaa, että ruokaterorismin ehkäisyyn on olemassa ohjeita ja että elintarvikeyritykset ja vedentoimittajat ovat tietoisia riskeistä ja varautuneita niihin.

## CENTRAL POINTS

- We studied experiences and perceptions of Finnish health and environmental health authorities on the probability of food terrorism and their preparedness to investigate food terrorism incidents.
- The authorities considered food terrorism a current risk and estimated that the possibility of food terrorism will increase during the following 10 years in Finland. Instructions to combat food terrorism were not included in the contingency plans of all respondents' operation areas.
- The preparedness for food terrorism could be strengthened at the national, regional, and local levels in Finland.

## BACKGROUND

Food terrorism is an act or threat of deliberate contamination of food or drinking water with chemical, biological, radionuclear (CBRN) or physical agents that aims to cause injury or death to civilian population and disruption of social, economic or political stability.<sup>1,2</sup> Food defence is an effort to protect food from act of terrorism. The health consequences of food terrorism can be extensive. For instance, in 1984, over 700 people acquired salmonellosis due to the deliberate contamination of salad bars at 10 local restaurants in Oregon, USA.<sup>3</sup> In addition to the direct effects on human health, food terrorism may also exert a substantial impact on the food economy. In the 1970s, Palestinian terrorists injected mercury into oranges and reduced Israel's exports of citrus fruit to Europe by 40%.<sup>4</sup> In 1989, Chilean grapes tested positive for cyanide, which led to international trade suspensions that cost Chile \$200 million.<sup>4</sup> The US Department of Agriculture has estimated that with an infectious disease, such as foot-and-mouth disease, on livestock could cost the US economy between \$10 billion and \$30 billion.<sup>4</sup> Food terrorism is one of the factors that can threaten the vital functions of society. In Finland, these functions are managed by a joint action of the authorities, food businesses, organizations and citizens, and the cooperation forms the basis for society's crises resilience.<sup>5</sup> In severe and exceptional circumstances, the state, wellbeing services counties and municipalities are responsible for ensuring food availability, quality and safety. These include the prevention of intentional contamination of food, in other words food defence.<sup>6</sup> National and regional risk assessments predict emerging events that

require actions from the authorities.<sup>7,8</sup> One of the actions is to maintain trust in food safety, food availability, and health and environmental health authorities.

Food terrorism is prevented by health authorities and environmental health authorities as well as food businesses and water supply operators.<sup>9</sup> In accordance with Finnish legislation, 60 municipal environmental health authorities (MEHA) oversee food and drinking water safety at the local level, which includes investigating food and waterborne outbreaks together with regional health authorities (RHA) located in 21 self-governing wellbeing service municipalities.<sup>10,11</sup> MEHA and RHA jointly staff a permanent food and waterborne outbreak investigation group that assembles when outbreaks occur to coordinate and execute the investigation activities. MEHA and RHA also play a central role in assessing the possibility of the deliberate contamination of food or drinking water in outbreak situations. Furthermore, MEHAs are responsible for the official control of food businesses and water supply operators.<sup>10</sup> While food business operators (FBO) and water supply operators are responsible for the safety of their food products and drinking water, including prevention of deliberate contamination, the responsibility of MEHAs is to assess how well the operators are prepared for such events.<sup>9</sup>

Minor incidents of the intentional adulteration of food products have been reported in Finland. In 2018, needles were found in food products in a grocery,<sup>12</sup> while in 2022 they were also found in food served at an elementary school<sup>13</sup>. The perpetrator in the first case was a lone individual with no clear motive. The second case has not been resolved. In addition, attempts to poison drinking water have been reported.<sup>7,14</sup> The incidents being rare, the Finnish authorities have little experience of recognising and handling intentional adulteration of food or drinking water at the national, regional and local levels.

The aim of this study was to investigate the experiences and perceptions of the local and regional authorities responsible for investigation of food and waterborne outbreaks regarding the probability of food terrorism and food defence. Such studies have not been conducted in Finland before.

## **MATERIAL AND METHODS**

A 1-week preparedness course on procedures for outbreak investigations for local and regional health and environmental health authorities is organized biennially–triennially by the Finnish Institute for Health and Welfare (THL), Finnish Food Authority, Finnish Defence Forces and the University of Helsinki. In June 2023, course participants responded to an online survey (using the survey platform Webropol) that charted their experiences and perceptions of food terrorism and preparedness of the authorities for such acts in Finland. The questionnaire consisted of two sections. The first section included questions on the respondents' field of work (health or environmental health), duration of employment in the current task and overall duration of work experience in that field of employment. The second section consisted of questions on the respondents' views and experiences of food terrorism, and perceptions of the probability of food terrorism now and in the future. Furthermore, we asked whether the authorities preparedness plan included precautionary measures for detection and investigation of food terrorism incidents and how well, according to the respondents, food and water supply operators had prepared for food

terrorism. Perceptions were measured with Likert-type questions collecting rank ordered responses while open-ended questions enabled the respondents to provide examples or clarify their opinions regarding the probability and prevention of food terrorism. The responses were collected and analysed in Excel.

## RESULTS

### Respondents

A total of 54/ 61 participants responded to the survey. They represented 90% (19/21) of the self-governing wellbeing services counties in Finland and were members of the municipal or regional food and waterborne outbreak investigation groups. Out of the respondents, 29 (54%) represented environmental health and 25 (46%) health authorities. The response rates were 88% and 86%, respectively. The respondents' median duration of employment in the field was 14 years (range 3 to over 15 years), while the median duration of employment in their current position was 1.5 years (range <1 to over 15 years).

### Experiences and perceptions of food terrorism

Most respondents (40/47; 85%) considered that food terrorism referred to the intentional CBRN contamination of food or drinking water and 96% (45/47) believed that it could affect the stability of society. All 47 respondents considered that food terrorism aimed to harm civilian population. The majority (42; 89%) considered that the same outbreak investigation detection and response systems would be used whether the event was intentional or unintentional, and 33 (70%) stated that identifying the outbreak caused by a deliberate act was often possible at a later stage of the outbreak investigation.

According to the respondents, the most likely acts of health terrorism to occur in Finland were adding of pathogens to food served to a large crowd and affecting military operational capacity by pathogens added to food or water (figure 1).

Of the respondents, 63% (28/43) listed war or hostile countries, 23% (10/43) acts of revenge by hostile individuals and 20% (9/43) weakened mental health as possible reasons behind the deliberate act of contamination of food or water. The health authorities considered deliberate contamination of food or water as a risk that could be realised more often than the environmental health authorities (20/22 vs. 15/25).

The respondents considered the likelihood of deliberate contamination of food or water would increase over the next 10 years (figure 2). In open answers, respondents mentioned as possible incidents deliberate chemical or radionuclear contamination, sabotage of the electrical network (resulting in spoilage of food and drink by breaking the cold chain), harming drinking water utility staff, introducing pathogens to swimming water and poisoning strategic individuals through food or water. Each of these was mentioned once. Forty (85%) respondents considered that it is important that the local contingency plan contains instructions for responding to the deliberate contamination of food or water. In the operation areas of 13 (28%) respondents, no such instructions were provided. The health authorities were more uncertain about the existence of such instructions than the environmental authorities (6/25 vs. 14/22). Of the respondents, 22/47 (47%) and 16/47 (34%) did not know whether local industry was prepared for the deliberate contamination of food or water, respectively. In the view of 16 health authority (73%) and 12

environmental health authority (48%) respondents, the food industry in their operation area took possible intentional contamination seriously. Eighteen health authority (82%) and 19 environmental health authority (76%) respondents considered that suppliers of drinking water gave serious consideration to this threat.

## DISCUSSION

The Finnish health and environmental health authorities consider food terrorism a current risk and estimate that the possibility of deliberate adulteration of food and drinking water increases in the future. The respondents comprehensively represented health and environmental health authorities in self-governing wellbeing services counties in Finland, and they possessed several years of experience in and insight into their fields of work. Replies to the questions appraising the authorities' knowledge of food terrorism indicated that the authorities share a common understanding of this phenomenon. This provides a good foundation to combat food terrorism.<sup>1</sup>

Pathogens such as viruses, parasites and bacteria, and their toxins can be used as bioweapons.<sup>15</sup> The respondents perceived that these risks are most likely to realise in Finland. Contaminating food or water served to military forces was emphasized, possibly reflecting the recent international disputes and Russia's attack on Ukraine. Although only a small number of documented attempts to poison military food supplies are known,<sup>16</sup> contaminated food or drinking water could be a powerful weapon and could affect the operational capability of military forces. For instance, the common pathogen norovirus has a small (<100 viral particles) infectious dose, exceptionally high (almost 100%) attack rate and short incubation period, and it is resistant to common disinfectants.<sup>17</sup> To prevent deliberate contamination, military forces should have a defence plan based on risk assessment. The plan should cover not only national service operations but also outsourced services as required in NATO operations.<sup>18</sup>

In almost one third of the respondents' operation areas, the contingency plan contained no instructions regarding food terrorism, although most respondents felt that such instructions were important. This indicates that preparedness in national, regional and local levels should be strengthened. The surveillance of food and waterborne outbreaks in Finland is designed and overseen by national authorities, but local outbreaks are detected and investigated at the local and regional level. National authorities provide support when needed.<sup>19</sup> Most respondents considered that the same surveillance system should also detect outbreaks caused by deliberate contamination. They also agreed that it is challenging in the early phase of the investigation to recognise whether an outbreak is intentional or unintentional, but this could be revealed later. The cause and source of the outbreak, the scope of the contamination and characteristics of the causal agent could reveal issues not typical for an unintentional outbreak.<sup>6</sup> For example, a waterborne outbreak without any preceding causal factors, such as floods, pipe breakages or cleaning process failures could point towards a deliberate act, therefore indicating the need for a more intensive investigation and collaboration between authorities and stakeholders. More than half the respondents anticipated that contaminating raw water supplies with human or animal faeces was a possible future threat. In Finland, there are around 1500 water supply plants, of which 400 are owned by municipal water companies and about

1100 by small cooperatives or other associations founded by users.<sup>20</sup> Although targeting a small-scale drinking water utility would cause illness to a limited number of people, such an act would create fear in society and uncertainty about the safety of the water. Spreading fear is the purpose of terrorist acts.<sup>1</sup> In Finland, 39% of the drinking water utilities use surface water to produce drinking water.<sup>21</sup> Contaminating such water supplies could be easy. It is also noteworthy that several break-ins to water supply plants were reported in Finland in 2024, raising concerns on water security.<sup>22</sup>

Finland's security strategy defines securing the supply of water as a strategic task, for which the Ministry of Agriculture and Forestry has the main responsibility (Government decision in principle on November 2, 2017). To secure the water supply, water plants must draw up a preparedness plan for disruptions and keep it updated.<sup>23</sup> The most significant challenges to Finnish water supply include scattered locations of the plants, aging infrastructure, shortage of financial and staff resources and the intensification of extreme weather phenomena caused by the climate change.<sup>24</sup> Many of these challenges may undermine the prevention of deliberate acts. Lack of resources, for example, may hinder the installation of fences around the water supply facilities.

One third of the environmental health authorities did not know the level of preparedness against food terrorism in the local food industry. This may be explained by the fact that while EU and national legislation requires environmental health authorities to inspect food businesses' food safety risk management, food defence is not emphasised<sup>25</sup> although terrorism targeted at the food supply chain is considered a potential risk in the EU.<sup>26</sup> In some countries, for example the USA, authorities help food businesses prepare for and respond to intentional adulteration and tampering<sup>6</sup>. Such practices could be advocated in Europe as well. Paying attention to food defence in the legislation and training central authorities to guide regional and local authorities could enhance food defence in Finland. Environmental health authorities that inspect food establishments could include food defence as an inspection area to increase awareness among FBOs. It is expected that food businesses with a certified food safety standard like FSSC 22000, which requires food businesses to possess a food defence plan, have considered threats such as sabotage and terrorism.<sup>27</sup> However, food businesses with no such certification may lack a plan to protect themselves from food terrorism. These businesses could benefit from using simple checklists for designing a food defence plan.<sup>28</sup> In addition, authorities inspecting food establishments should pay attention to the prevention and identification of deliberate food contamination.

The survey showed that health authorities, more often than environmental health authorities, anticipated that deliberate contamination of food and water would occur in the future. It would be

interesting to further investigate the differences in the views between health and environmental health authorities and ensure that they possess a common understanding of the threats, so that preparedness measures would be prioritized in a coordinated manner.

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## CONCLUSIONS

The preparedness for food terrorism should be strengthened at national, regional, and local levels in Finland. The national food and water safety authorities should guide regional and local authorities in food defence contingency planning. The regional and local authorities should ensure that food businesses and water suppliers are aware of the potential risks and have prepared for deliberate contamination.

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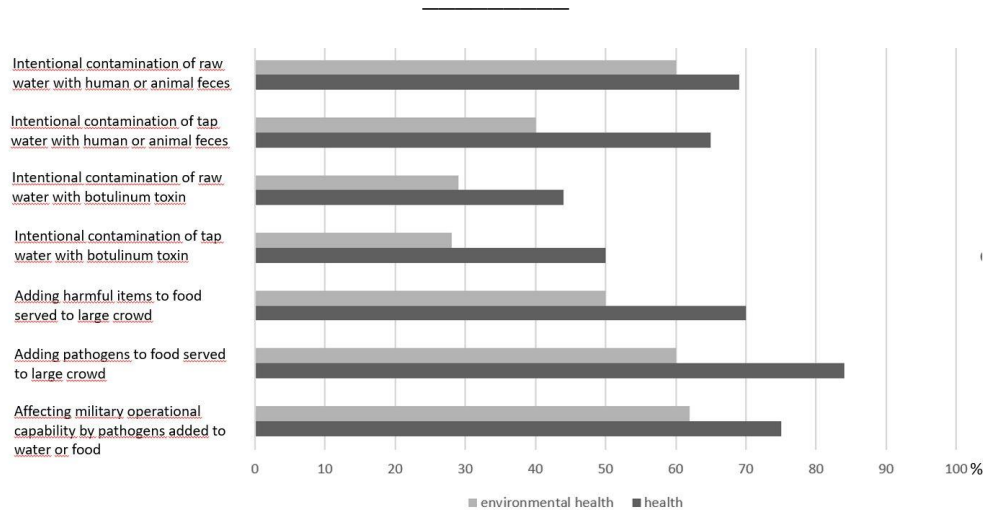
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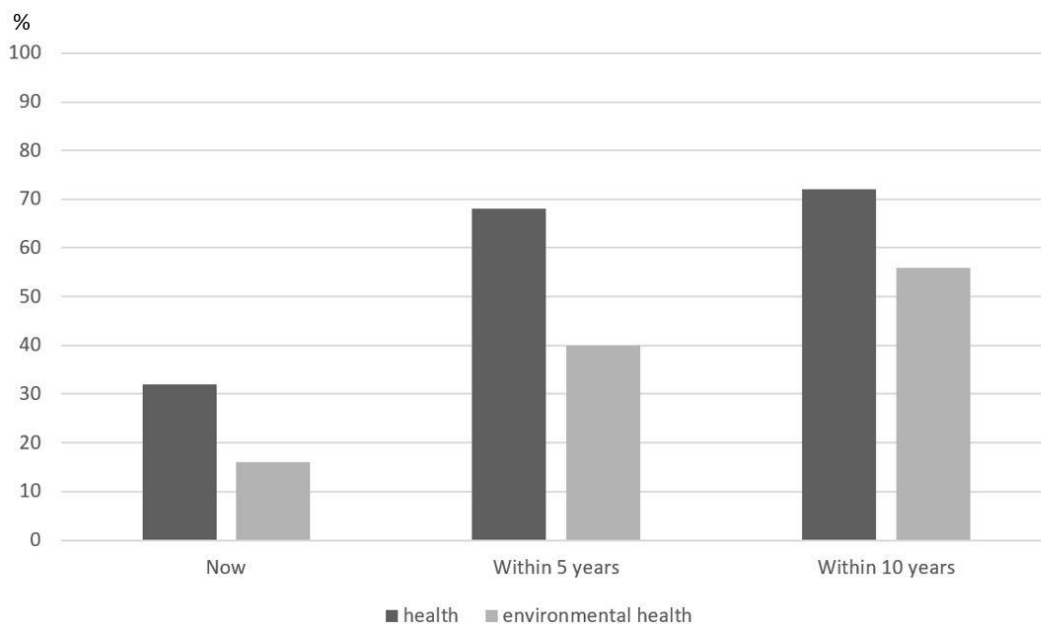
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**FIGURE 1 KUVA**

Proportion of respondents stating that currently the following threats were or may be present in Finland.

Vastaajien näkemys riskien suuruudesta Suomessa.



**FIGURE 2 KUVA**

The probability of deliberate contamination of food and water within next 10 years according to health (n=25) and environmental health authorities (n=29)

Terveystieteiden (n=25) ja ympäristöterveydenhuollon (n=29) viranomaisten näkemys ruuan ja veden tahallisen saastuttamisen todennäköisyydestä Suomessa seuraavien 10 vuoden aikana.