- *Toxoplasma gondii* is an intracellular protozoan parasite with three different infectious stages: tachyzoites, bradyzoites in tissue cysts, and sporozoites in oocysts.

- *T. gondii* infection often remains asymptomatic in humans, depending on the strain, but if primary infection is acquired during pregnancy, it can cause serious health problems in the foetus

- Disease-burden estimates due to *T. gondii* infections in various countries have demonstrated the overall high public health impact of toxoplasmosis.

- *FERG DALY's: ranked 3nd in Europe; 2nd FBP in NL*
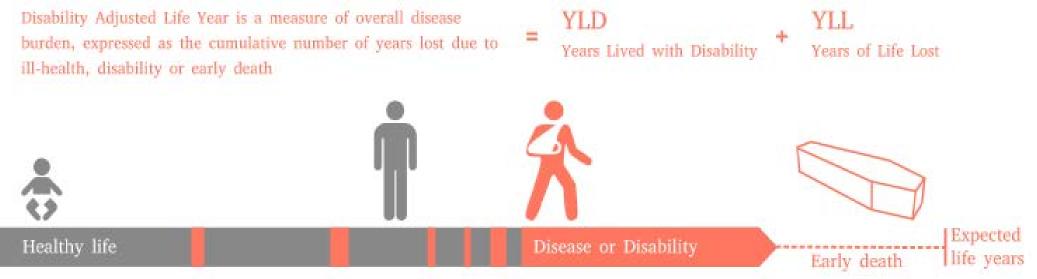
- *Cost MCDA ranked 2nd in Europe*

Quantifies the health status of a population
Expressed in Disability Adjusted Life Years (DALY)

DALY integrates morbidity and mortality in a single index.

Compare different diseases (Cancer-Cardiac- Infectious diseases



**DALY**

Disability Adjusted Life Year is a measure of overall disease burden, expressed as the cumulative number of years lost due to ill-health, disability or early death

$=$ **YLD** Years Lived with Disability $+$ **YLL** Years of Life Lost

Healthy life — Disease or Disability — Early death | Expected life years

# Surveillance and monitoring of *T. gondii*

- In humans: national surveillance differ between countries. Only congenital toxoplasmosis is reported to ECDC. In 19 MS and Iceland, a compulsory surveillance system is implemented.

- In animals: No EU Regulation exists with relation to the surveillance and monitoring of *Toxoplasma gondii* in animals. The main animal species tested are small ruminants, cattle, pigs and, cats and dogs using samples from aborted animals or clinically suspected animals.

- *Euro-FBP Cost action: analyses of surveillance systems in animals and humans*

- In 2017, 40 cases of congenital toxoplasmosis were reported in the EU by 20 MS. The EU notification rate was 1.31 cases per 100,000 live births.

- The highest country-specific notification rates were observed in Slovenia and Poland (9.8 and 4.7 cases per 100,000 live births, respectively).

- It is not possible to make a good estimate of the prevalence of congenital toxoplasmosis in the EU, as only three MS have an active surveillance system of congenital cases.

- *NL: survey in newborns: 2 per 1000 newborns CT positive according to IgM titer*

- *CT underreporting in Europe!!!*

# *Toxoplasma* infections in animals



- The highest overall prevalence of *Toxoplasma* infections in animals was detected in small ruminants (13.1%) and pigs (15%) followed by cattle (10.5%).
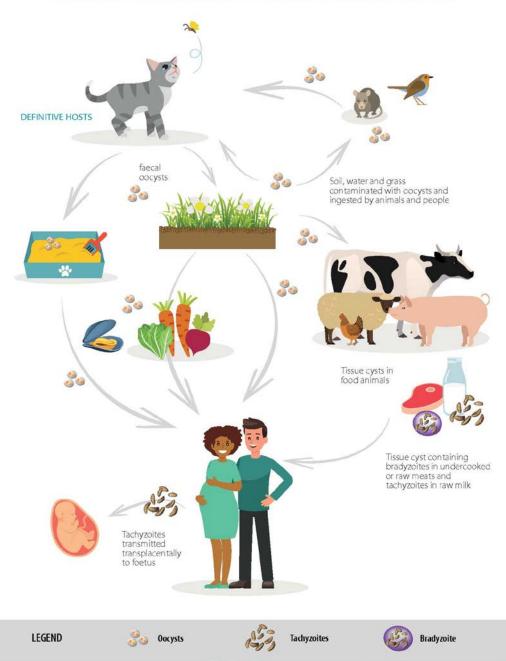
- Most samples were obtained from clinical investigations.

  - It is not possible to make a good estimate of the prevalence of *Toxoplasma* infections in animals due to the use of different diagnostic methods, different sampling schemes and lack of information on the animals' age and rearing conditions.

  - *Prevalence data not reflecting real epidemiological situation and human risk in Europe!!!*

# *Toxoplasma gondii*

- Foodborne transmission is considered to be the main mode for transmission to humans

- Tissue cysts and tachyzoites are responsible for infections via meat and milk, respectively

- Sporulated oocysts in the environment can contaminate fresh produce, shellfish, and water and infect humans after consumption.



FOODBORNE TRANSMISSION PATHWAYS FOR *TOXOPLASMA GONDII*

DEFINITIVE HOSTS

faecal oocysts

Soil, water and grass contaminated with oocysts and ingested by animals and people

Tissue cysts in food animals

Tissue cyst containing bradyzoites in undercooked or raw meats and tachyzoites in raw milk

Tachyzoites transmitted transplacentally to foetus

LEGEND    Oocysts    Tachyzoites    Bradyzoite

# *Toxoplasma gondii* detection in food

- Most commonly used detection methods for meat are mouse bioassay, followed by cat bioassay and PCR based methods

- Bioassays have the advantage that they can detect viable and infective *T. gondii* in contrast to PCR-based methods, but have the disadvantage of using experimental animals

- MC-PCR based method can detect one tissue cyst in 100 g of meat, only few, not validated, methods for other food products

- *EFSA toxoplasmosis project 2013-2015*

# *Toxoplasma gondii* occurrence in food

- Meat-producing animals may harbour *T. gondii* cysts in their tissues and can pose a risk to consumers of rare and undercooked meat.

- *EFSA study in 4 countries: 1,6% BA positive slaughtered cattle.*

- Molecular diagnostics have been used to show the occurrence of *T. gondii* as a faecal contaminant of fresh produce and in the tissues of molluscan shellfish

- Raw milk and fresh cheese made from animals infected with *T. gondii* may pose a risk of transmission through tachyzoites shed in the milk

# *Toxoplasma gondii* foodborne pathways

- Data suggests that foodborne transmission accounts for 40–60% of the *T. gondii* infections.

- Major contributing food sources are meat (beef, pork, and small ruminants' meat) and vegetables.

- Source attribution mainly based on expert knowledge elicitation.

QMRA meatborne predicted incidence Netherlands:

- 2011: 67% beef and 35% filet americain! (Opsteegh et al., 2011)

- 2019: 85% beef and 80% filet americain! (Deng etal., 2019 submitted)

# *Toxoplasma gondii* control

- For swine and small ruminants, serology can be useful to identify positive farms which then need to take measures to reduce exposure

- Not useful for cattle since there is no correlation between seropositivity and presence of tissue cysts

- Vaccination of sheep and pigs

- Temperature treatment for meat: freezing / heating

- Developing a vaccine for use in cats that would prevent or reduce the shedding of oocysts into the environment

*High vaccination coverage needed.98%*

*Parasite specific control measures mentioned*

- **On-farm measures** that reduce the likelihood of faecal contamination may be more effective than post-harvest interventions.

- In general, methods for analysing foods as vehicles of infection for these three parasites are not well established, standardised, or validated.

- Robust and reliable methods for detection of the three parasites on different foods need to be developed and validated.

- *More knowledge of relative importance of foodborne transmission: Data needed to perform QMRA*

- *Recommendations to reduce foodborne transmission*

# EJP-OH: Toxosource to quantify different sources of T. gondii

What are the relative contributions of the different sources of *T. gondii* infection?

**Expected results**

1. Quantitative estimates of the sources and transmission routes of *T. gondii*, as well as of the geographical differences, to inform risk management. QMRA meat products and fresh produce

2. Novel and improved source attribution models and methods to trace the sources and transmission routes of *T. gondii*. Sporozoiete specific ELISA to detect oocysts borne infections

3. Outcomes providing an excellent basis for the development of innovative and effective interventions at national, regional, European and global levels. Identify risk factors for human infection.