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From the Division of Global Health (IHCAR), Department of Public Health Sciences

**Antibiotic Resistance and Environmental Factors:
Focusing on the Situation in Odisha, India**

ACADEMIC DISSERTATION

For the degree of PhD at Karolinska Institutet

The thesis will be defended in public at Rockefeller lecture hall, Nobels väg 11,
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ABSTRACT

Background: The rise of antibiotic resistant bacteria is a major challenge to global public health. The environment has a significant impact on health and infectious diseases; however, there is a lacuna of information on the relationship between the environment and antibiotic resistance.

Aim: The overall aim of this thesis was to explore the relationship between antibiotic resistance and environmental components.

Methods: This study was conducted in Odisha, India. In Paper I, eight focus group discussions and ten individual interviews among community members without any healthcare background, and in Paper II, 24 interviews among healthcare professionals: allopathic doctors, veterinarians and drug dispensers from two different environmental settings were conducted. In Paper III, studies were conducted to investigate the antibiotic resistance pattern of *Escherichia coli* isolated from samples of children's stool, cow-dung and drinking water from two geographical regions: non-coastal (230 households) and coastal (187 households). Paper IV investigated the association of temperature and relative humidity with occurrence of skin and soft-tissue infections (SSTIs, n=590), *Staphylococcus aureus* associated skin infections (SA-SSTIs, n=387) and methicillin-resistant *S. aureus* (MRSA, n=251) during a period of 18 months in case of outpatients in a tertiary care hospital in Bhubaneswar.

Findings: Participants perceived a relationship between environmental factors, infectious diseases and antibiotic use and resistance. It was perceived that behavioural and social environmental factors, i.e. patients' non-compliance with antibiotic use, irrational prescription by informal as well as trained healthcare providers and over-the-counter availability of antibiotics are the major contributors for antibiotic resistance development. It was also perceived that natural and physical environmental factors are associated with the occurrence and prevalence of infectious diseases and antibiotic resistance (Paper I & II). When quantitative studies were conducted, it was found that the overall prevalence of antibiotic resistance in *E. coli* isolated from children's stool, cow-dung and drinking water was higher in the non-coastal than the coastal environment (Paper III). In Paper IV it was revealed that the maximum temperature above 33°C and minimum temperature above 24°C coinciding with relative humidity between 55% to 78% is a favourable combination for the occurrence of SSTIs, SA-SSTIs and MRSA infections; this combination of temperature and relative humidity is observed during late summer in Odisha.

Conclusions: Although behavioural and social environmental factors are major contributors to resistance development; natural and physical environmental factors also influence antibiotic resistance development. There was geographical variation in antibiotic resistance. It was also evident that climatic factors have influence on skin and soft-tissue infections and resistant bacteria. There is a need for further research on the influence of natural and physical factors on antibiotic resistance development and for education, information dissemination and proper implementation and enforcement of legislation at all levels of the drug delivery and disposal system in order to improve antibiotic use and minimise resistance development.

Key words: environment, antibiotic resistance, coastal, non-coastal, skin and soft-tissue infections, *E. coli*, *S. aureus*, MRSA, qualitative, time-series, Odisha, India

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