

Risk assessment in an estuarine environment

a case-study in the Sado Estuary

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INTRODUCTION

Previous environmental studies on Sado river estuary indicated high concentrations of heavy metals (Cu, Zn, Ni, As, Cr, e Pb) in sediments possibly linked to industrial contamination along with non-point anthropogenic sources. This contamination was already detected on some species living in the estuary which can reflect and amplify local contamination, posing potentially serious health problems to humans. Local population has intense fishing activity and along with agriculture products, fishery products of the estuary are daily available for local residents.

Chronic heavy metal exposure is associated with renal and neurological diseases (especially in children during brain development) and most heavy metals are also classified as carcinogenic and teratogenic. In this geographical area, studies of human exposure routes and its potential health effects due to heavy metals were never conducted.

The HERA project* (Environmental Risk Assessment of a contaminated estuarine environment) is an integrated, multidisciplinary research project that aims to evaluate environmental risks including ecologic and to human health and includes an epidemiological study aiming to characterize exposure pathways to estuarine products and its potential health effects

OBJECTIVES

- To characterize exposure routes, health status, health determinants, and use of health care of all individuals residing in the target population, and
- To compare the same variables with those from a population sample of residents near another estuarine (considered a pristine estuary).

METHODS

Study Design: A cross-sectional comparative study of residents in Carrasqueira (exposed population) and residents in a second different population, Vila Nova de Mil Fontes (VNMF), selected as the non-exposed population (Figure 1).

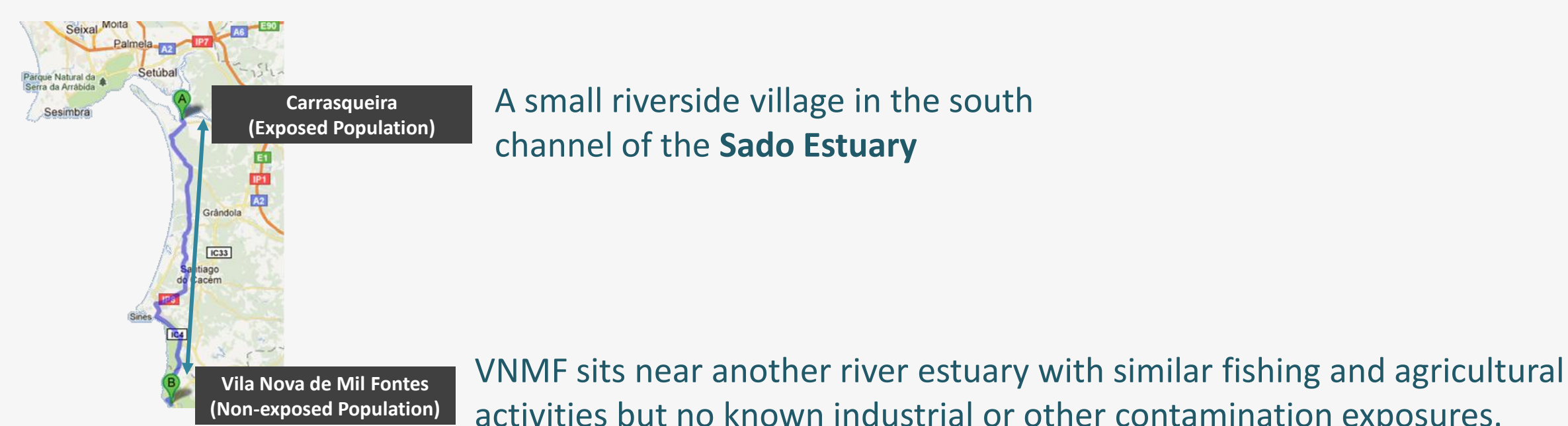


Figure 1. Geographical localization of the population under study

Ethical procedures: The study protocol and the questionnaire was submitted and approved by the “Comissão de Ética do Instituto Nacional de Saúde Dr Ricardo Jorge, I.P” and by “Comissão Nacional de Protecção de Dados”.

Dissemination of the study: In order to increase the level of the participation, leaflet and posters were created and distributed in both population.

Sampling: The sample was selected from the list of registered users of the National Health Service.

Contact with selected participants: One week before the scheduled day for data collection, a letter was sent to each selected participant, explaining the purpose of the study and asking for participation of the contacted person. The envelope contained the invitation letter, a leaflet and contacts for any clarification.

Data collection: Data on exposed and non-exposed population was collected at home by trained interviewers by face to face interviews of selected individuals using Computed Assisted Personal Interview (CAPI). All participants were included after a written informed consent.

Final questionnaire was composed by 31 questions related to the following themes:

- 1) Health effects: morbidity, use of health services, reproductive history;
- 2) Potential routes of exposure: socio-demographic, occupational (fishing and farming related occupations), leisure activities and hobbies (including recreational fishing), lifestyles (tobacco);
- 3) Potential routes of human contamination from the estuary (including use of water, subsistence fishing and farming).

RESULTS

A total of 202 participants were included in the study: 102 in Carrasqueira (response rate =72.9%) and 100 in VNMF (response rate =45.7%)

Exposure Factors

Table 1. Profession	Location			
	Carrasqueira (exposed)		VNMF (unexposed)	
	n	%	n	%
Managers, Professionals and Armed forces occupations	8.8	8.7	10.4	10.4
Technicians and associate professionals	12.5	12.3	32.9	32.9
Skilled agricultural, forestry and fishery workers; ..; plant and machine operators, and assemblers	67.5	66.2	44.5	44.5
Elementary occupations	11.3	11.1	12.2	12.2

Comparison between exposed and unexposed: statistical significant differences in bold (p<0.05); n, number of valid answers

Table 2. Past or present Leisure Activities	Location			
	Carrasqueira (exposed)		VNMF (unexposed)	
	n	%	n	%
Fishing	99	41.4	94	18.1
Agriculture	99	59.6	94	19.1
Painting/ Joinery/Carpentry	102	6.9	100	5.0
Domestic activities (include gardening)	102	26.5	100	14.0
Others activities	102	18.6	100	25.0

Comparison between exposed and unexposed: statistical significant differences in bold (p<0.05); n, number of valid answers

Table 3. Exposure Behaviors	Location			
	Carrasqueira (exposed)		VNMF (unexposed)	
	n	%	n	%
Fish Consumption from estuary or fish market	102	98.0	100	77.0
Farming Products Consumption from Own/familiar/friends farms	102	99.0	100	88.0
Consumption of water from well and hole	99	62.6	100	1.0
Utilization of water from well and hole to cook	102	81.4	99	2.0
Utilization of water in farm from the well, hole and channel river	102	94.9	99	80.0

Comparison between exposed and unexposed: statistical significant differences in bold (p<0.05); n, number of valid answers

Health Effects

Table 4. Chronic heavy metal related morbidity	Location			
	Carrasqueira (exposed)		VNMF (unexposed)	
	n	%	n	%
At least one disease	102	32.4	100	20.0
1 disease	102	16.7	100	14.0
2 diseases	102	11.8	100	6.0
3 ou more diseases	102	3.9	100	0.0

Comparison between exposed and unexposed: statistical significant differences in bold (p<0.05); n, number of valid answers

Table 5. At least one...	Comparison			
	Carrasqueira (exposed)/ VNMF (unexposed)		OR adjusted*	
	OR	CI95%	OR adjusted*	CI95%
Chronic heavy metal related disease	1.91	(1.00;3.64)	2.10	(1.02;4.30)
Pregnancy with Miscarriages (<20 Weeks) or Fetal Deaths	0.65	(0.29;1.47)	---	---
Pregnancy with Abnormal outcomes	1.53	(0.47;4.92)	---	---

A higher odd of having chronic heavy metal related morbidity and pregnancies with abnormal outcomes were observed in Carrasqueira;

After adjustment, the odd risk of having at least one chronic heavy metal related disease was 2.1 (statistically significant).

CONCLUSIONS

The population of Carrasqueira had higher frequency of :

1. Professions like fishers and agricultures that are more likely to have higher risks of exposure to estuary river contaminants (directly or indirectly);
2. Leisure activities with higher probability of exposure
3. Consumption of fish from the local estuary or fish market, farming products, as well as water use for drinking, cooking and farming coming from well, holes or the channel river

4. Carrasqueira location showed unfavorable morbidity and reproductive history indicators

For future developments, the data analysis will be expanded to include data on food intake.

Further studies should use bioindicators of exposure (such as heavy metals on blood) and outcome (clinical data)

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