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HBM4EU science and policy for a healthy future

HORIZON2020 Programme
Contract No. 733032 HBM4EU

# Report on ongoing activities and existing data and data gaps

## Deliverable Report

## D7.8

### WP7 - Survey design and fieldwork preparation

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# 2 Glossary

| | |
| --- | --- |
| D7.8 | Deliverable 7.8 |
| FMUL | Faculdade de Medicina da Universidade de Lisboa / Lisbon School of Medicine |
| HBM | Human Biomonitoring |
| IPCheM | Information Platform for Chemical Monitoring |
| NHCP | National Hub Contact Point |
| PI | Principal Investigator |
| GDPR | General Data Protection Regulation |
| SD | Standard deviation |

# 3 Abstract/Summary

Human Biomonitoring (HBM) has long been used by scientists as a tool to assess human exposure to chemicals. The recent expansion of HBM as a key field of study has brought an exponential increase of scientific production in the area and an additional difficulty of developing tools to consistently map ongoing or concluded, but not published, studies. Within the context of Task 7.1 of the HBM4EU initiative, an online easily accessible HBM platform compiling studies and samples addressing the 1st and 2nd prioritiy substances was developed, based on the 2017 and 2018 questionnaire. This platform entails both published and unpublished work, thus addressing the difficulties of identifying under-reported studies.

Some of the platform functionalities include: i) severel levels of access for registered users, ii) personalised search by key indicators and possibility to download the search results, iii) easy navigation throughout the main areas of the questionnaire, including a variable map to effortlessly navigate to specific indicators in the platform, iv) summary of statistics of the studies included in the platform.

So far, 153 studies were included in the online platform. Existing data also show the following:

- The countries with the higher number of reported studies are Belgium, Italy, Spain and Austria, with no reported information yet for Bulgaria, Estonia, Hungary, Ireland, Luxembourg, Poland and North Macedonia
- The majority of the reported studies were conducted in the east, west and north of Europe, and only a small percentage is from the south
- Most of the reported studies have a national or regional scope
- Projects are almost all concluded or ongoing but some planned studies were also identified
- Studies reported in the platform followed mainly cross-sectional or longitudinal designs
- Almost all HBM studies included in the platform have been conducted within the general population and a large percentage had as target adult and children populations (although there is a variability in terms of studies' sample sizes).
- The substances of the first round of prioritisation were the most analysed ones and from the second group of prioritisation no study analysed diisocyanates
- Blood and urine were the matrices most frequently used to study the chemical substances across the reported studies and a large percentage of studies keep biobanked samples
- More than half of the studies allow partial or full access to the biobanked samples, to the overall collected data and to the questionnaires used for data collection

Data harmonisation is more and more a key resource to support research in several scientific areas. Towards this effort, investment has been made to gather comparable data from different studies. Although the integration of data from different studies in various geographical regions is challenging, this is an important endeavour towards advancement in the production of quality research.

# 4 Introduction

Human Biomonitoring (HBM) has long been used by scientists as a tool to assess human exposure to chemicals[1]. Aside from its quite extensive history, only recently HBM research has become generalised[2]. The expansion of HBM as an important field of study has brought the proliferation of studies in the area. Reflection of this growth is the exponential increase of scientific production. This has, however, important repercussions since the map of ongoing or concluded, but not published, studies is not always easy. The challenge that the scientific community now faces in this area relies on the identification, integration and harmonisation of the existing (often scattered) data, to produce relevant, soundful and comparable evidence-based knowledge and to ascertain data gaps.

HBM4EU is a joint effort of 30 countries, the European Environment Agency and the European Commission, co-funded under Horizon 2020, with the primary goal of generating evidence about the exposure of citizens to chemicals and itspossible health effects, in order to support policy making[3]. Within this framework, one of HBM4EU main aims is to harmonise HBM activities and procedures undertaken in the partner countries. As first steps towards the harmonisation of procedures and the production of comparable data, it is important to a) identify and integrate HBM data from existing studies, and b) identify data gaps in this area.

In this context, task 7.1 aims to identify HBM concluded, ongoing or planned studies, projects or activities (including available biobank samples) on an European level for the prioritised substances within HBM4EU. The gathered data can then be used to inform the HBM4EU Consortium regarding priority areas of intervention.

Deliverable 7.8 will compile the work developed in 2020 in Task 7.1, namely the creation of an online easily accessible HBM platform which compiles studies and samples addressing the 1$^{st}$ and 2$^{nd}$ prioritiy substances available in the HBM4EU Consortium. This platform entails both published and unpublished work, thus addressing some of the abovemetioned difficulties.

This deliverable was initially planned to report ongoing activities and existing data and data gaps for the 3$^{rd}$ prioritised substances (including a list of metadata that can be uploaded in IPCheM). However, since the third round of prioritisation, which aims to identify priorities for research under a future European Human Biomonitoring initiative post 2021, is still ongoing, D7.8 presents the main results about HBM research data and data gaps based on the analyses of the information reported in the Task 7.1 platform until November 2020.

# 5 Scope of Task 7.1 activities

Task 7.1 aims to identify relevant (concluded, ongoing and planned) studies, projects and activities, as well as biobanked samples of the HBM4EU consortium for the prioritised substances.

## 5.1 Platform development

The 2018 version of the NHCP-questionnaire[4], which was initially developed within Task 7.1 in 2017[5], was entirely relocated to a new online platform, which can be accessed through the following link: http://hbmjps.topick.pt/. This was done given the need to have a permanently accessible and open (to data insertion) questionnaire to the Principal Investigators of the reported studies so they could easily visualise and update their data at any time. Moreover, attending to the HBM4EU requirements of providing valuable information on HBM (for chemical policy making), additional features, identified as relevant, were made available for the consortium, namely data access, search and visualisation.

### 5.1.1 Platform technical specifications

The platform was implemented on a portal with Microsoft SQL database as the basis for all the information to be processed.

The platform was developed in MS Visual Studio on ASP.NET platform, with the information created and located in a Microsoft SQL Server database:

- ASP.NET development
- Database: Microsoft SQL Server 2016

The requirements are: i) Windows server 2016 environment with IIS, ii) Microsoft SQL Server 2016 or higher, iii) Microsoft .Net Framework 4.7.2 or higher.

The platform complies with confidentiality issues, having the following accreditations of the National Security Office:

- National industrial security accreditation in the SECRET degree
- NATO industrial security accreditation at NATO SECRET grade
- U.E industrial security accreditation: SECRET U.E.

### 5.1.2 Platform functionalities

The platform (http://hbmjps.topick.pt/) has the following functionalities:

**#1** A layout aligned with the HBM4EU image.

**#2** The homepage has a summary of statistics of the studies included in the platform: total number of studies (and number of studies segmented by status), number of variables (i.e., the total number of questions in the platform), and the number of targeted persons (the sum of all the reported sample sizes for all studies) (Figure 1).

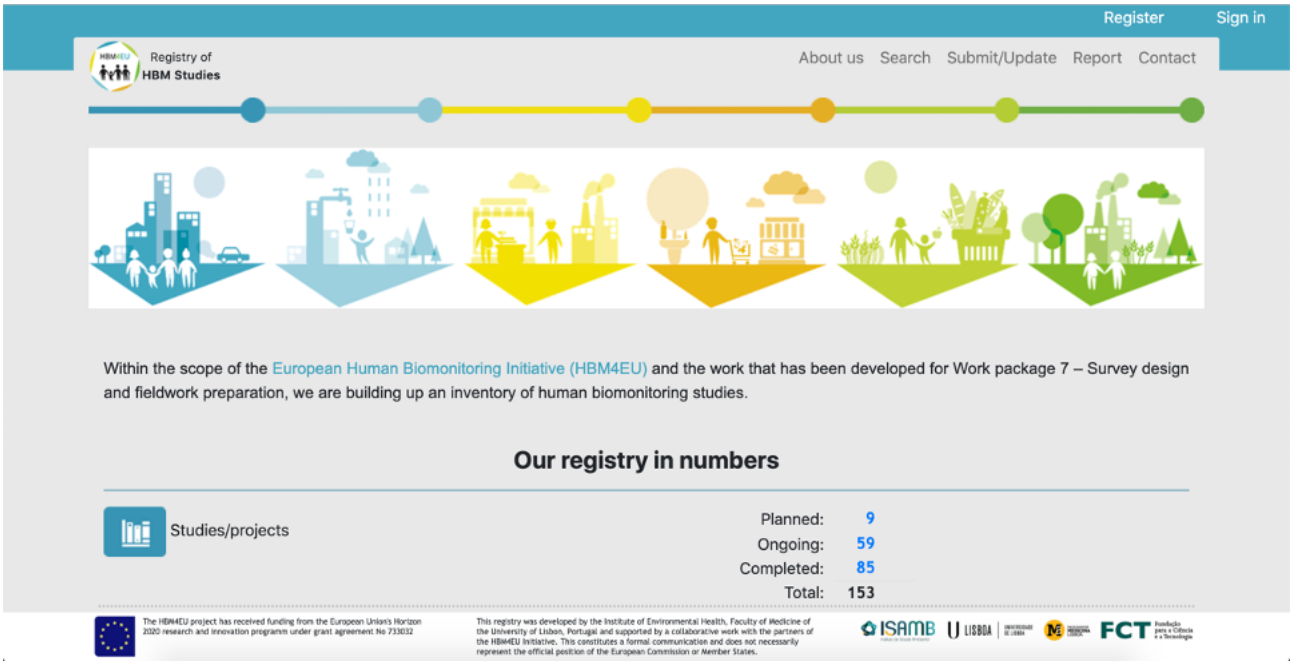


**Figure 1: Task 7.1 Platform homepage**

**#3** To have access to more in-depth information about the studies, consortium members can make a register and then login whenever they want to enter the platform.

Here, following the GDPR, severel levels of access for the registered users were defined:

i) Reader – Assigned to all members of the consortium who are not a Principal Investigator (PI) or contact person of a given study; this user can only have access to the Homepage, About us, Search, Report and Contact tabs and cannot make any downloads of the consulted information.

ii) Updater – Contact person defined by the PI of a given study to update the data of that PI's studies; this user can have access to the Homepage, About us, Search, Submit/Update, Report and Contact tabs and can make downloads of the consulted information. In the Search tab, like Reader, this user can see the summary of all studies in the platform but in the Submit/Update can only have access to the detailed information of the studies to whom he/she was assigned to and is not able to add new studies to the platform.

iii) Author – PI of a given study; has the same priviledges of the Updater but can add new studies to the platform.

iv) Supervisor – Designated members of the coordination of the HBM4EU consortium who can have access to all of the platform's data, except for the user management.

v) Manager – Task 7.1 leaders who are the platform managers and can access all the information, including user management.

**#4** Some basic information regarding the platform, within the HBM4EU initiative, is provided in the "**About us" tab**, complementing the introductory information presented in the Homepage. Also, relevant links for additional information in the HBM4EU website, namely in terms of prioritised substances, is provided in this tab (Figure 2).


**Figure 2: Task 7.1 Platform About us page**

#5 In the "**Search" page**, it is possible to search by some main indicators: Name of the study/project/activity, acronym, country or countries (of data collection), substance or substances under study, status and biological samples analysed (Figure 3).

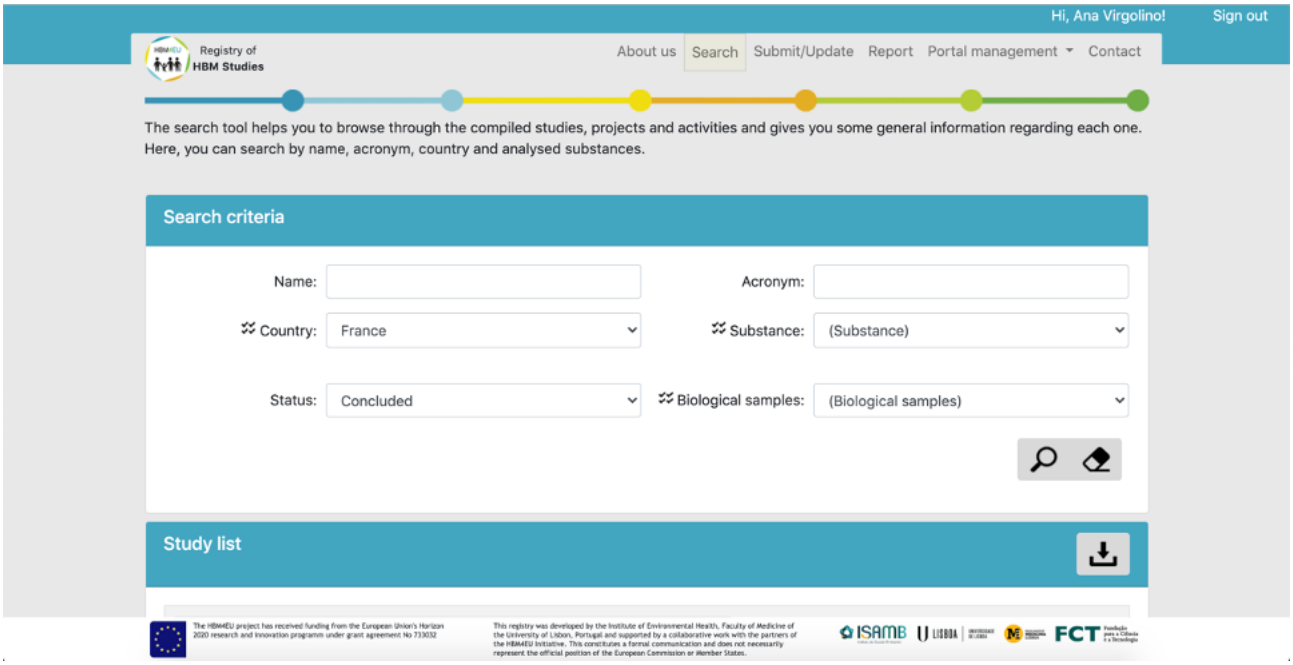


**Figure 3: Task 7.1 Platform Search page**

By clicking on each study/project/activity, it is possible to have access to an identity card of the study, with a summary of the main information: name, acronym, name of the PI, project status, beginning and end date, study design, analytical methods, countries of data collection, substances under study, general objectives and project website (Figure 4).

The search results can be downloaded to an excel file (not for readers).

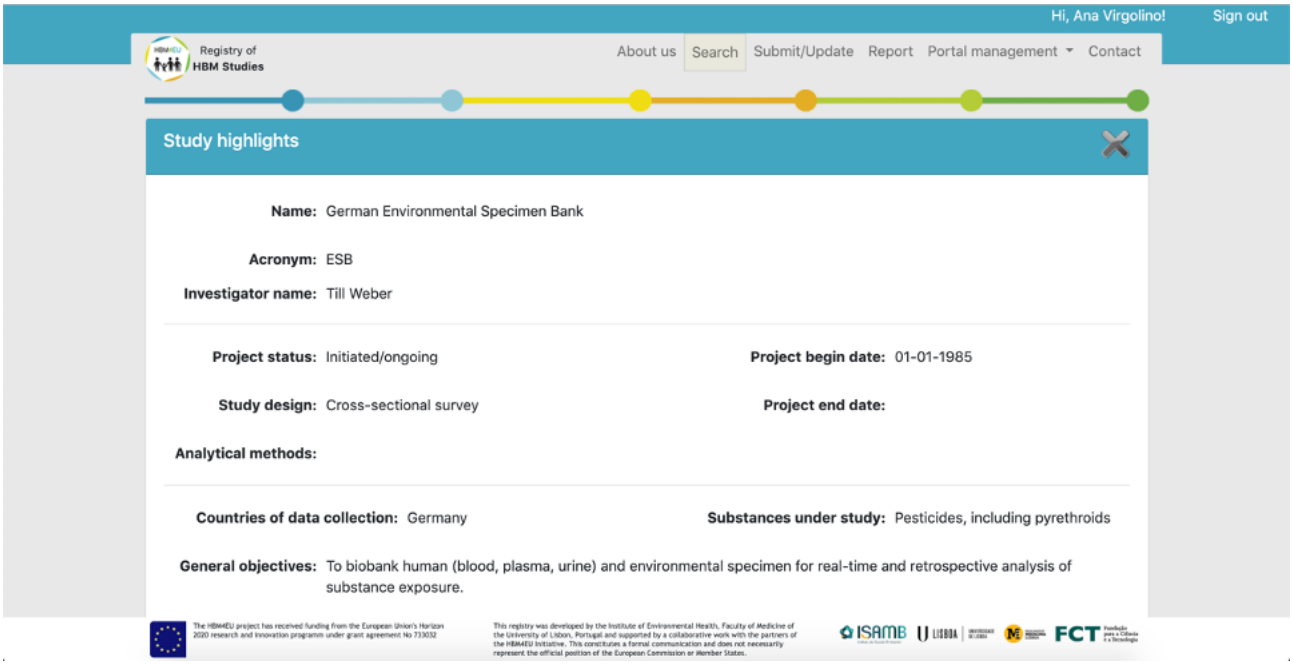


**Figure 4: Task 7.1 Platform Search page with study highlights**

#6 As in the previous questionnaire, in the **Submit/Update tab**, the information is organised by sections which allows an easy navigation throughout the questions (Figure 5). The questionnaire has nine main sections

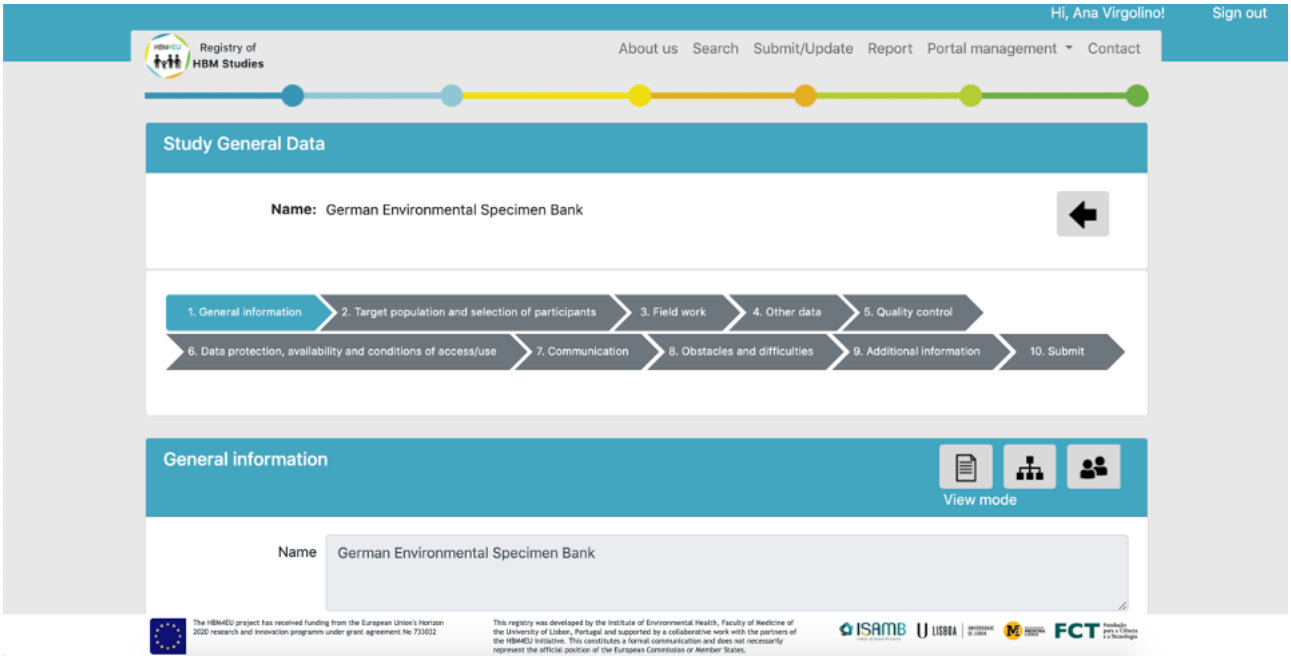


**Figure 5: Task 7.1 Platform Submit/Update page**

Also, new studies can be reported at any time. Whenever a new study is created, the study stays in “quarantine” until the validation of the platform manager. In case of need, and before the study/project/activity is made available in the search catalogue, the PI will be asked to make some corrections to the reported data.

Moreover, the platform has a variable-set map (Figure 6). If a PI needs to update any specific information in one study, the navigation to that point of the questionnaire is made easier. If the

search word used to locate the section of the questionnaire needing updates returns more than one section, each time the person press “enter”, the platform will sequentially indicate where the word appears in the questionnaire.

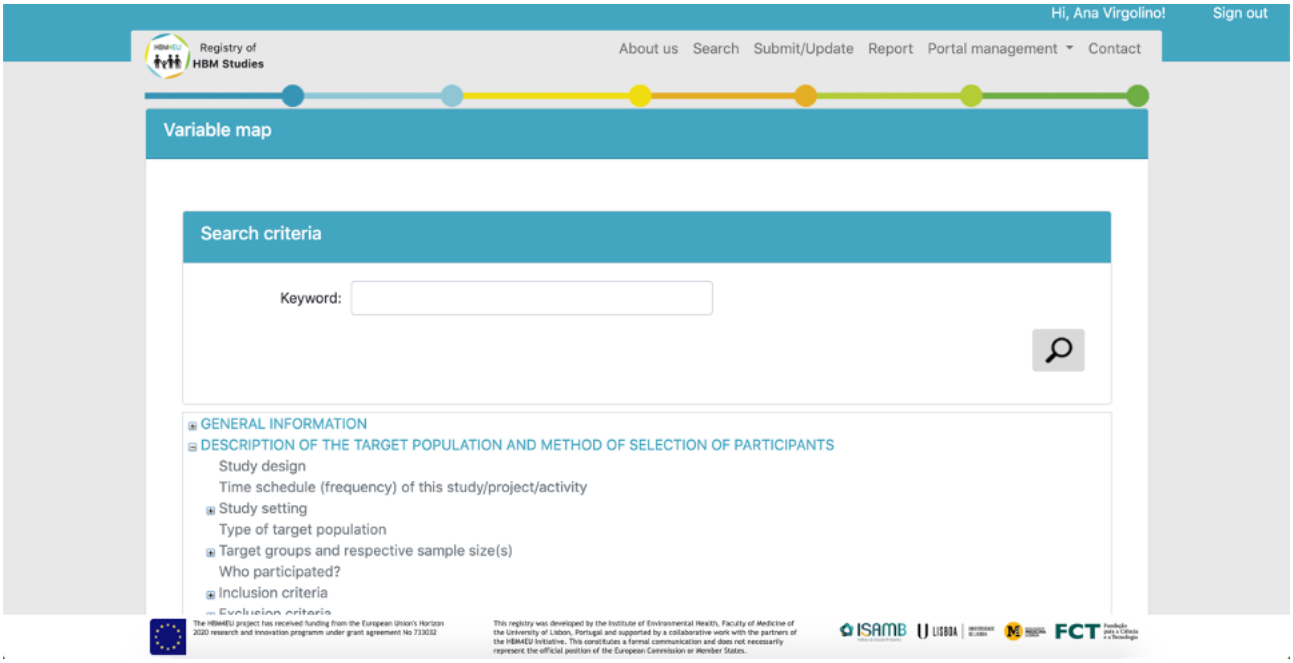


**Figure 6: Task 7.1 Platform variable map**

**#7** In the **Report tab**, it is possible to have access to a summary of statistics of the data included in the platform (Figure 7).

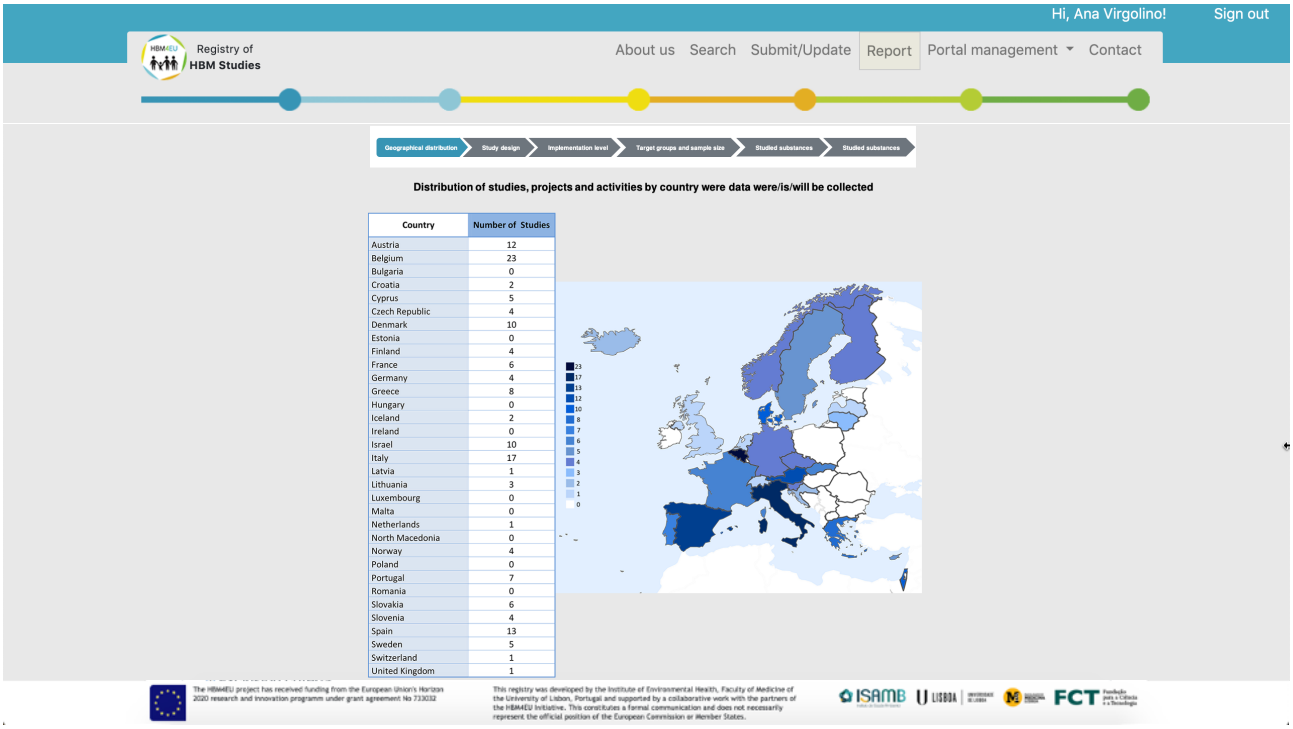


**Figure 7: Task 7.1 Platform variable map**

**#8** The platform has also a **Contact page**. Here, platform users can find contact details for technical support in case of need (Figure 8).

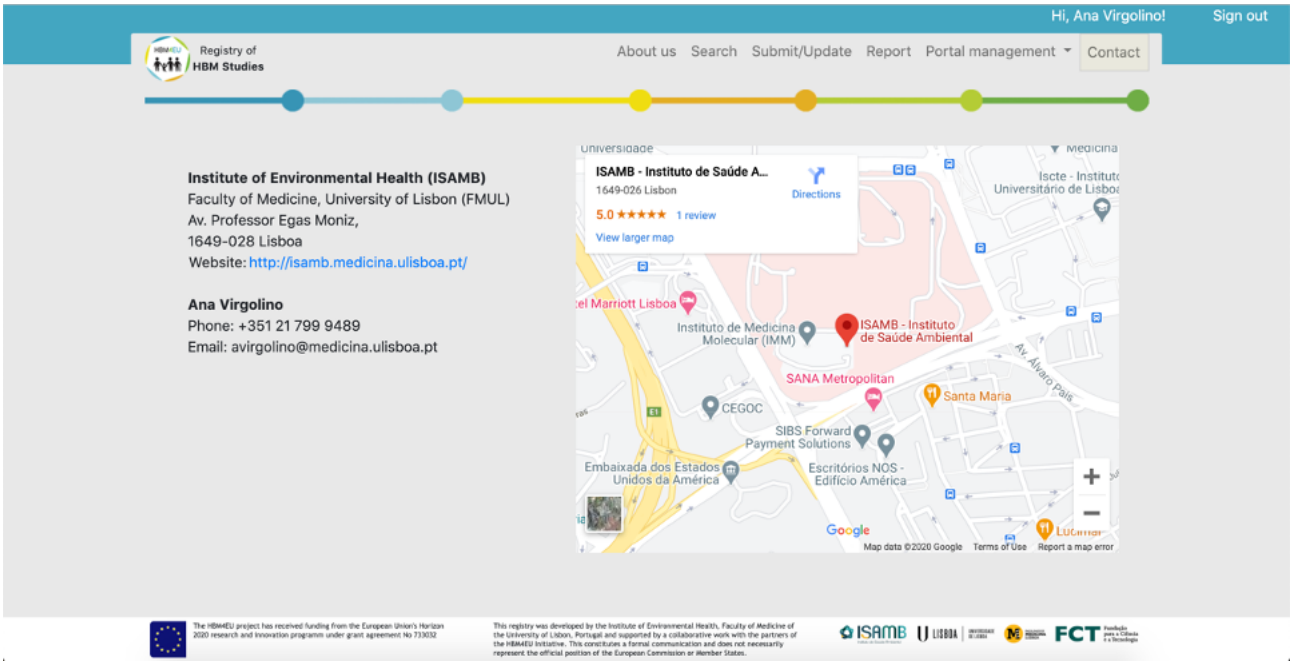


**Figure 8: Task 7.1 Platform Contact page**

### 5.1.3 User experience

Once all platform's main features have been developed, it was assessed in terms of user interaction regarding usability, visual appearance and content appropriateness. Main goals at this phase were to report on intuition, ease of interaction and usability parameters, as well as on satisfaction concerning the interaction with the platform. This was a pivotal stage in the process of developing the platform in order to assure that it was ready to be used.

In this assessment, a combination of quantitative and qualitative assessment methods was employed. First, a group cognitive interview with six FMUL researchers was used to characterise the decision making and reasoning skills of exposed subjects while they navigate in the platform. Moreover, satisfaction and perception of ease-of-interaction were also assessed. Then, free observation of platform use by two of the FMUL researchers was employed to evaluate interfaces for optimal user experience and to diagnose usability problems. Produced data was then used to optimise user experience, platform's performance and layout details before the pilot test.

### 5.1.4 Pilot study and platform dissemination

In a first phase, in the second trimester of 2019, and after a first version of the platform was completed, Task 7.1 partners in 2019 were contacted and asked to test the platform and provide their inputs regarding layout, structure and contents (namely questions).

Additionally, in the third trimester of 2019, some of the PIs of the studies reported in 2017 and 2018 in the previous Task 7.1 questionnaire were contacted and asked to register and navigate in the platform so they could check the need for any changes that would facilitate the use of the platform. Based on the feedback received, additional layout and structural modifications were implemented in the platform.

Then, in July of 2020, after the finalisation of a consolidated version of the platform, all of the PIs were contacted by email, and asked to make their registry and check for the update of available information.

# 6 Existing studies reported in the platform

## 6.1 Data and data gaps

An overall characterisation of the studies included in the platform is presented below, describing the variables that were considered important to depict existing data and data gaps from the studies of the consortium. The platform, however, has information on nine major areas, each of the them with several indicators, has shown in Figure 9, with a total of 263 indicators. The complete list of indicators in the platform in provided in Appendix 1.


**Figure 9: Platform indicators**

### 6.1.1 Geographical distribution

At the time this report was written (November 2020), 153 studies were included in the online platform.

The countries with the highest number of studies reported at the platform are Belgium (23), Italy (17), Spain (13) and Austria (12) (Figure 10). For the country members of the HBM4EU consortium, no studies were reported yet for Bulgaria, Estonia, Hungary, Ireland, Luxembourg, Poland and North Macedonia.

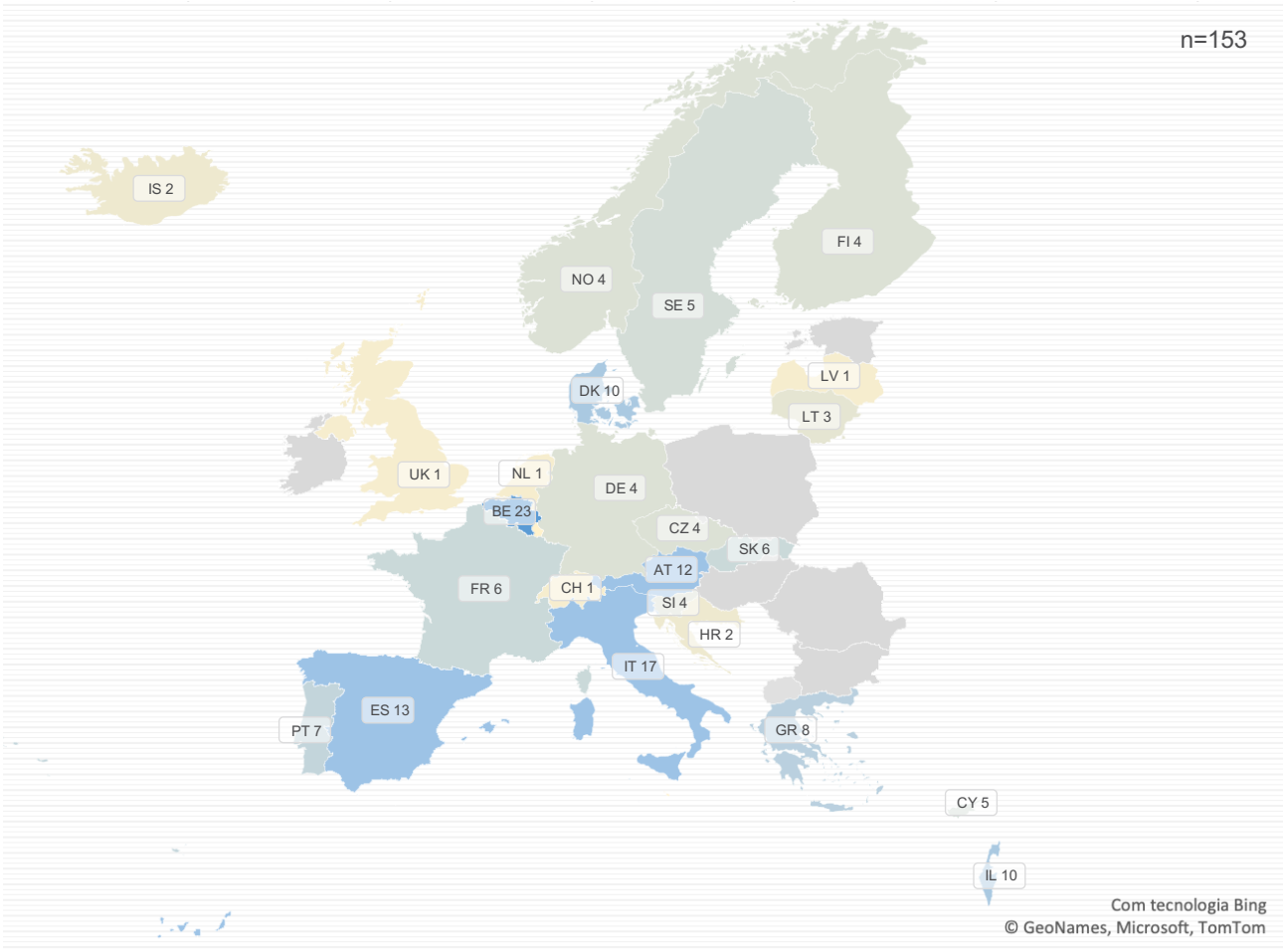


**Figure 10: Number of studies, by country**

Note: Data presented in this Figure refer to the indicator “Country of the Institution responsible for the study/project/activity implementation”. There are, however, studies implemented in more that one country (please see Table 1)

As presented in Figure 11, the majority of the reported studies were conducted in the east, west and north of Europe, and only 7% were undertaken in countries of the south of the European-defined regions.

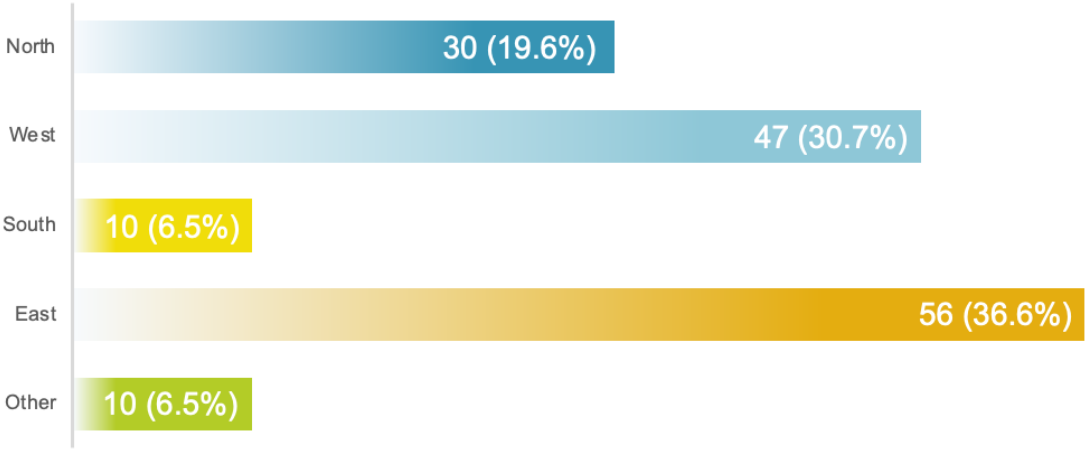


**Figure 11: Number (and percentage) of studies by European-defined region (n=153)**

Note: European-defined regions:
*North*: Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
*West*: Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland
*South*: Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain
*East*: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia
*Other*: Israel

Most of the reported studies (85.0%) have a national or regional scope, though nearly 11.0% were implemented at the international level (Figure 12).


**Figure 12: Studies' implementation level (n=153)**

The distribution of studies by European-defined regions shows that national (50.0%) and international (40.0%) studies are mainly being developed in the south, whereas studies with a regional scope are the main focus of western (44.7%) and eastern (44.6%) regions. In other regions (namely Israel), 40.0% of the reported studies had a national scope and and 50.0% were regional (Table 1).

**Table 1: Studies' implementation level by European-defined regions**

| | European-defined region | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | North n (%) | West n (%) | South n (%) | East n (%) | Other n (%) | Total n (%) |
| **International** | 4 (13.3) | 1 (2.1) | 4 (40.0) | 7 (12.5) | - | 16 (10.5) |
| **National** | 14 (46.7) | 23 (48.9) | 5 (50.0) | 21 (37.5) | 4 (40.0) | 67 (43.8) |
| **Regional** | 11 (36.7) | 21 (44.7) | 1 (10.0) | 25 (44.6) | 5 (50.0) | 63 (41.2) |
| **Local** | 1 (3.3) | 2 (4.3) | - | 3 (5.4) | 1 (10.0) | 7 (4.6) |

Note 1: European-defined regions:
*North* - Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
*West* - Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland
*South* - Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain
*East* - Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia
*Other* - Israel

Note 2: The symbol '-' is used for no cases

### 6.1.2 Overall study status

More than half of the studies included in the platform (55.6%) are already concluded. About 39% of the reported studies are still ongoing or initiated projects, and nearly 6% are from planned studies (Figure 13).

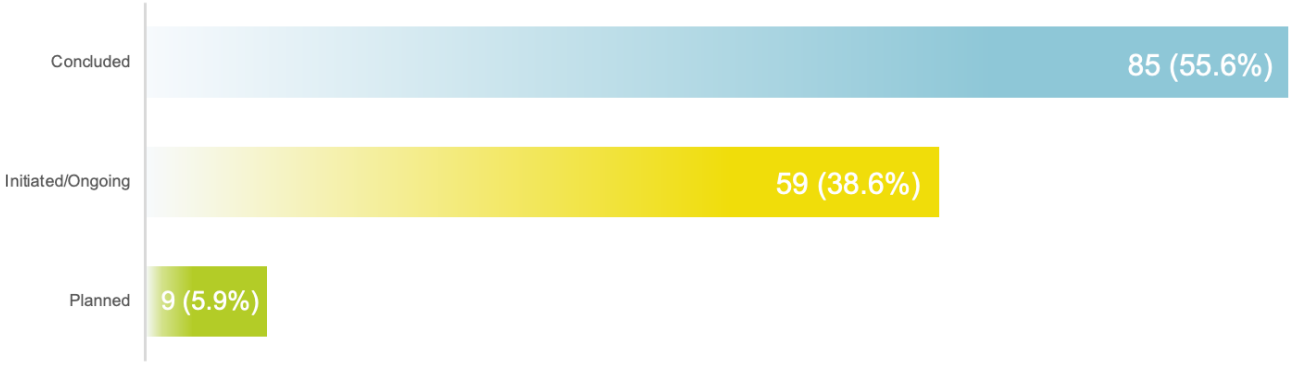


**Figure 13: Status of the reported studies (n=153)**

Table 2 presents the distribuition of studies in each European-defined region by study design. It is visible that the west and the east regions, respectively, have a larger percentage of concluded studies, compared with the other regions which include more initiated/ongoing studies. It was in the east region that the largest amount of planned studies was reported.

**Table 2: Status of the studies by European-defined region**

| | European-defined region | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | North n (%) | West n (%) | South n (%) | East n (%) | Other n (%) | Total n (%) |
| **Concluded** | 14 (46.7) | 33 (70.2) | 4 (40.0) | 31 (55.4) | 3 (30.0) | 85 (55.6) |
| **Initiated/Ongoing** | 15 (50.0) | 13 (27.7) | 6 (60.0) | 19 (33.9) | 6 (60.0) | 59 (38.6) |
| **Planned** | 1 (3.3) | 1 (2.1) | - | 6 (10.7) | 1 (10.0) | 9 (5.9) |

Note 1: European-defined regions:
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*East* - Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia
*Other* – Israel

Note 2: The symbol '-' is used for no cases

### 6.1.3 Study design

Studies reported in the platform followed mainly a cross-sectional (51.6%) or longitudinal (35.9%) design (Figure 14).

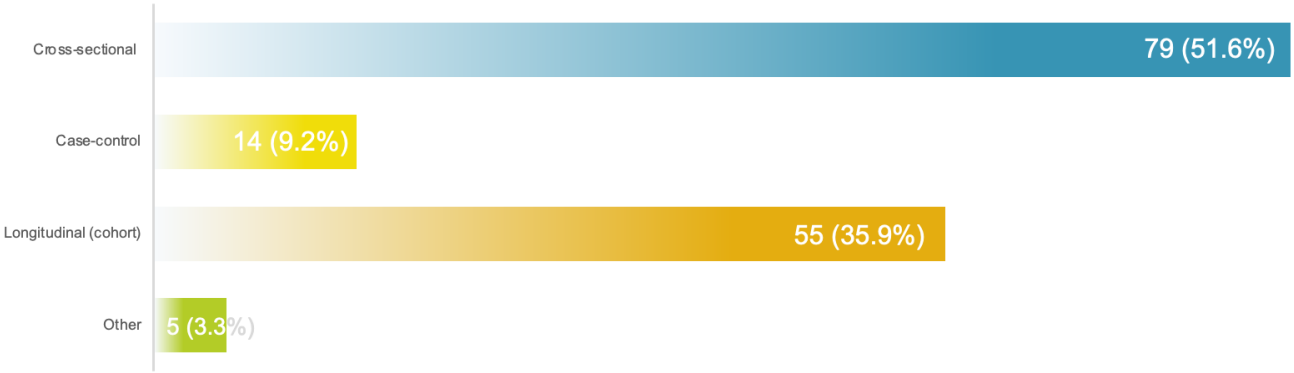


**Figure 14: Design of the reported studies (n=153)**

Considering the European-defined region, the west, east and north concentrated the majority of cross-sectional studies, while for the south and the other regions the distribution of cross-sectional and longitudinal studies is almost similar (Table 3).

**Table 3: Study design for each European-defined region**

| | European-defined region | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | North n (%) | West n (%) | South n (%) | East n (%) | Other n (%) | Total n (%) |
| Cross-sectional | 13 (43.3) | 26 (55.3) | 5 (50.0) | 30 (53.6) | 5 (50.0) | 79 (51.6) |
| Case-control | 3 (10.0) | 1 (2.1) | - | 9 (16.1) | 1 (10.0) | 14 (9.2) |
| Longitudinal (cohort) | 13 (43.3) | 17 (36.2) | 5 (50.0) | 16 (28.6) | 4 (40.0) | 55 (35.9) |
| Other | 1 (3.3) | 3 (6.4) | - | 1 (1.8) | - | 5 (3.3) |

Note 1: European-defined regions:
*North* - Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
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*East* - Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia
*Other* - Israel

Note 2: The symbol '-' is used for no cases

### 6.1.3 Target population

Figure 15 shows that almost all HBM studies included in the platform have been conducted within the general population and only 5 (3.3%) had as main target clinical populations. The same scenario is found in a distribution of the studies by European-defined region (Table 4).

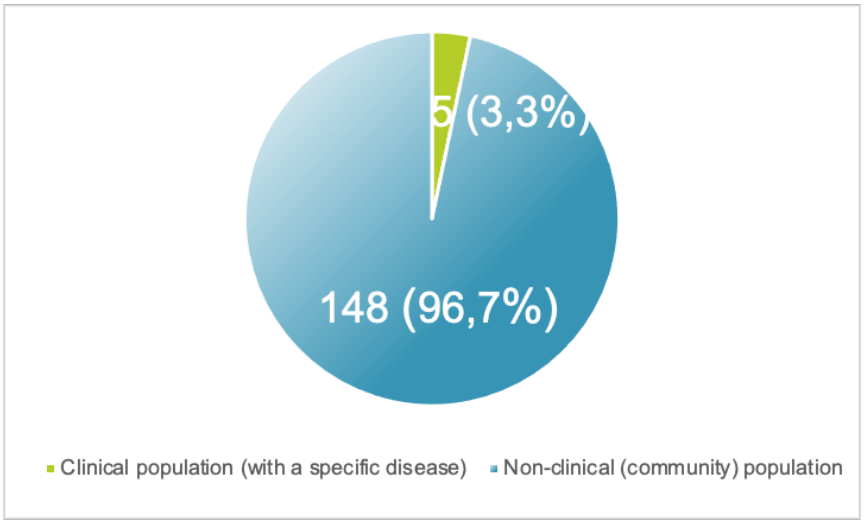


**Figure 15: Type of population (clinical and non-clinical) of the reported studies (n=153)**

**Table 4: Clinical and non-clinical populations of the studies for each European-defined region**

| | European-defined region | | | | | |
|---|---|---|---|---|---|---|
| | North n (%) | West n (%) | South n (%) | East n (%) | Other n (%) | Total n (%) |
| Clinical population (with a specific disease) | 1 (3.3) | 0 (0.0%) | - | 1 (1.8) | 3 (30.0) | 5 (3.3) |
| Non-clinical (community) population | 29 (96.7) | 47 (100.0) | 10 (100.0) | 55 (98.2) | 7 (70.0) | 148 (96.7) |

Note 1: European-defined regions:
*North* - Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
*West* - Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland
*South* - Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain
*East* - Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia
*Other* - Israel

Note 2: The symbol '-' is used for no cases

Out of the 153 studies in the platform, almost half (73) were conducted with adults and 55 entailed children as the target group. Only seven studies assessed pregnant women and 14 assessed elderly populations (Figure 16).

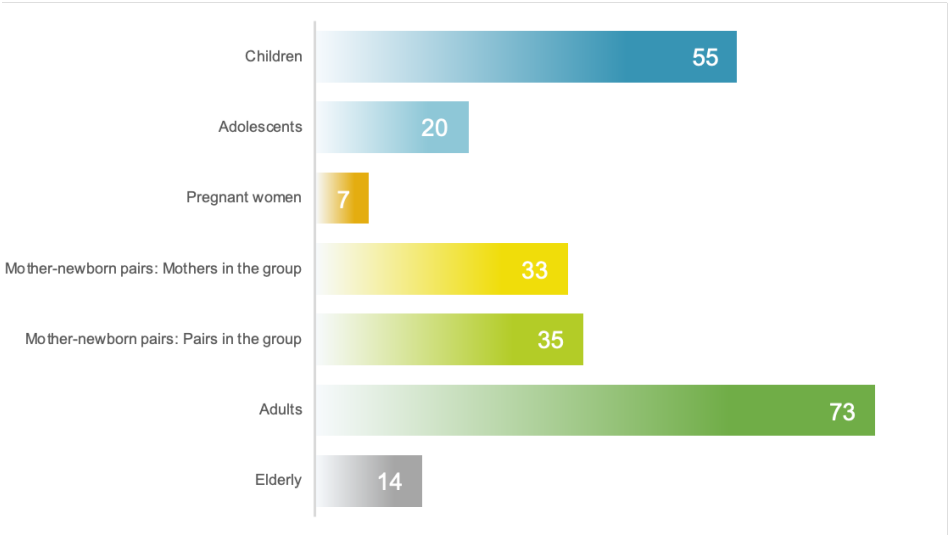


**Figure 16: Number of studies by target groups**

Note: Data presented in this figure refer to a multiple-choice question. The sum of reported studies does not correspond to the total of answers included in the platform in each option.

Note 2: Children - 0-11 years old; Adolescents - 12-19 years old; Adults - 20-59 years old; Elderly - >59 years old

The groups of adults and children are the most well represented among the reported studies, and the variability of sample size is visible for these two groups (Figure 17 and Table 5). Although in smaller number, the studies targeting elderly are the ones, on average, with the largest sample size (9351 individuals), followed by the studies with adults (4560 individuals).

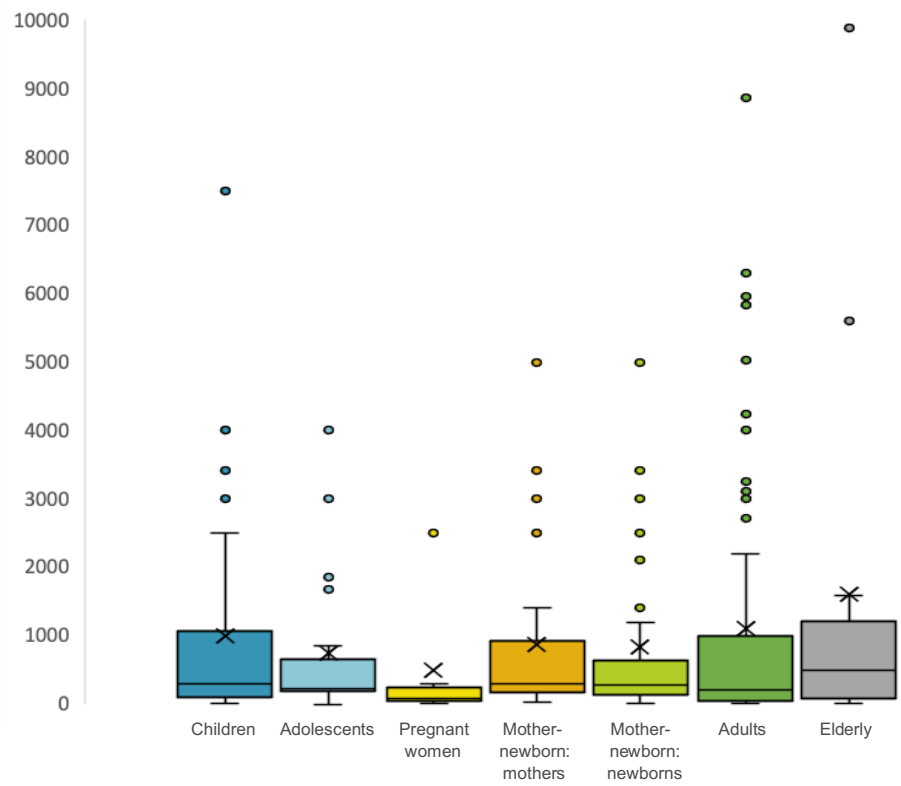


**Figure 17: Target groups and sample sizes: mean, median, standard deviation, minimum and maximum**

Note 1: Extreme values are not represented in the figure (in children: 18300; in pregnant women: 114000; in mother-newborn pairs - mothers in the group: 10000 and 18000; in mother-newborn pairs - pairs in the group: 10000 and 18000; in: adults: 18000, 18696, 110000 and 110000; in elderly: 110000)

Note 2: Children - 0-11 years old; Adolescents - 12-19 years old; Adults - 20-59 years old; Elderly - >59 years old

Note 3: Data presented in this table refer to a multiple-choice question. The sum of reported studies does not correspond to the total of answers included in the platform in each option.

**Table 5: Target groups and sample sizes: mean, median, standard deviation, minimum and maximum**

| | Children | Adoles-cents | Pregnant women | Mother-newborn: Mothers in the group | Mother-newborn: Pairs in the group | Adults | Elderly |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Mean** | 1317 | 748 | 16715 | 1661 | 1581 | 4560 | 9351 |
| **Median** | 300 | 229 | 110 | 300 | 281 | 209 | 600 |
| **SD** | 2949,592 | 1080,779 | 42908,01 | 3542,131 | 3460,893 | 18140,365 | 29102,292 |
| **Minimum** | 11 | 0 | 8 | 20 | 10 | 10 | 17 |
| **Maximum** | 18300 | 4000 | 114000 | 18000 | 18000 | 110000 | 110000 |

Note: Children - 0-11 years old; Adolescents - 12-19 years old; Adults - 20-59 years old; Elderly - >59 years old

An analysis by region shows that in all European-defined regions, the main target population of the reported studies were adults (followed by children) (Table 6).

**Table 6: Studies by target population for each European-defined region**

| | European-defined region | | | | | |
|---|---|---|---|---|---|---|
| | North n (%) | West n (%) | South n (%) | East n (%) | Other n (%) | Total n (%) |
| **Children** | 9 (30.0) | 25 (53.2) | 8 (80.0) | 27 (48.2) | 5 (50.0) | 74 (48.4) |
| **Adolescents** | 2 (6.7) | 11 (23.4) | 1 (10.0) | 5 (8.9) | 1 (10.0) | 20 (13.1) |
| **Adults** | 23 (76.7) | 32 (68.1) | 9 (90.0) | 33 (58.9) | 8 (80.0) | 105 (68.6) |
| **Elderly** | 2 (6.7) | 5 (10.6) | 1 (10.0) | 6 (10.7) | - | 14 (9.2) |

Note 1: European-defined regions:
*North*: Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
*West*: Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland
*South*: Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain
*East*: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia
*Other*: Israel

Note 2: Children - 0-11 years old; Adolescents - 12-19 years old; Adults - 20-59 years old; Elderly - >59 years old

Note 3: The above age groups were grouped into four categories: Children includes “children” and “children in the mother-child pairs”; Adults include “pregnant women”, “mothers in the mother-child pairs” and “adults”

Note 4: Data presented in this table refer to a multiple-choice question. The sum of reported studies does not correspond to the total of answers included in the platform in each option.

Note 5: The symbol ‘-‘ is used for no cases

### 6.1.4 Chemical substances under study

The substances of the first round of prioritisation were the most analysed ones among the reported studies. Worth to mention that no study analysed diisocyanates (from the second round of prioritisation) (Figure 18).

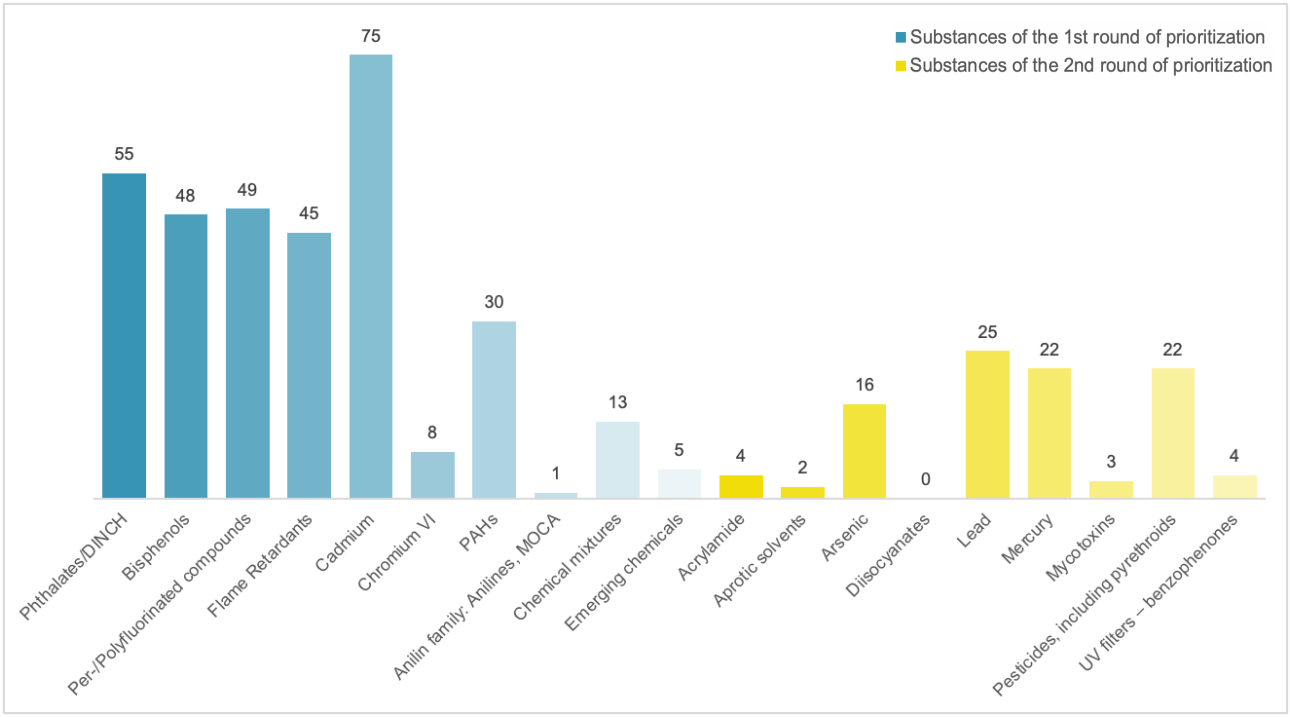


**Figure 18: Number of studies which analysed the prioritised (first and second round) substances**

The distribution of the various analysed substances by region is presented in Table 7.

**Table 7: Chemical substances analysed in each European-defined region**

| | European-defined region | | | | |
| --- | --- | --- | --- | --- | --- |
| | North n (%) | West n (%) | South n (%) | East n (%) | Other n (%) |
| **Phthalates/DINCH** | 8 (26.7) | 16 (3.4) | 27 (48.2) | 1 (10.0) | 3 (30.0) |
| **Bisphenols** | 6 (20.0) | 18 (38.3) | 20 (35.7) | 2 (20.0) | 2 (20.0) |
| **Per-/Polyfluorinated compounds** | 9 (30.0) | 17 (36.2) | 21 (37.5) | 2 (20.0) | - |
| **Flame Retardants** | 10 (33.3) | 11 (23.4) | 21 (37.5) | 2 (20.0) | 1 (10.0) |
| **Cadmium** | 14 (46.7) | 20 (42.6) | 32 (57.1) | 3 (30.0) | 6 (60.0) |
| **Chromium VI** | 2 (6.7) | 2 (4.3) | 3 (5.4) | - | 1 (10.0) |
| **PAHs** | 4 (13.3) | 10 (21.3) | 11 (19.6) | 2 (20.0) | 3 (30.0) |
| **Anilin family: Anilines, MOCA** | - | 1 (2.1) | - | - | - |
| **Chemical mixtures** | 1 (3.3) | 7 (14.9) | 5 (8.9) | - | - |
| **Emerging chemicals** | 1 (3.3) | 1 (2.1) | 3 (5.4) | - | - |
| **Acrylamide** | - | - | 3 (20.0) | 1 (14.3) | - |
| **Aprotic solvents** | - | - | 1 (6.7) | 1 (14.3) | - |
| **Arsenic** | 1 (20.0) | 4 (28.6) | 7 (46.7) | 2 (28.6) | 2 (28.6) |
| **Diisocyanates** | - | - | - | - | - |
| **Lead** | 3 (60.0) | 6 (42.9) | 9 (60.0) | 4 (57.1) | 3 (42.9) |
| **Mercury** | 2 (40.0) | 6 (42.9) | 8 (53.3) | 1 (14.3) | 5 (71.4) |
| **Mycotoxins** | - | - | 2 (13.3) | - | 1 (14.3) |
| **Pesticides, including pyrethroids** | 3 (60.0) | 7 (50.0) | 6 (40.0) | 4 (57.1) | 2 (28.6) |
| **UV filters – benzophenones** | - | 1 (7.1) | 1 (6.7) | 1 (14.3) | 1 (14.3) |

Note 1: European-defined regions:
*North*: Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
*West*: Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland
*South*: Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain
*East*: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia
*Other*: Israel

Note 4: The symbol '-' is used for no cases

The distribution of group of substances assessed by European-defined region and age group is presented for concluded (Figure 19), initiated/ongoing (Figure 20) and planned (Figure 21) studies.

In those studies that are already concluded (Figure 19), it is in the west and east regions that several target populations were more frequently included. In the north and south the studies focused mainly children and adults. However, contrary to what is observed for the other regions, in the north, the number of analysed chemical substances was smaller, having entailed only substances from the first round of prioritisation.

For the initiated/ongoing studies (Figure 20), the few number of reported information for the south region is visible. Notwithstanding, the other regions have a more even distribution of studies focusing the prioritised substances in different target populations.

Given the small number of reported planned studies (Figure 21), the north and south regions do not have identified studies. Even in the west only two studies were reported, focusing the analysis of phthalates/DINCH and bisphenols in children. The east is the region from which more studies were reported, though focusing only children and adults.

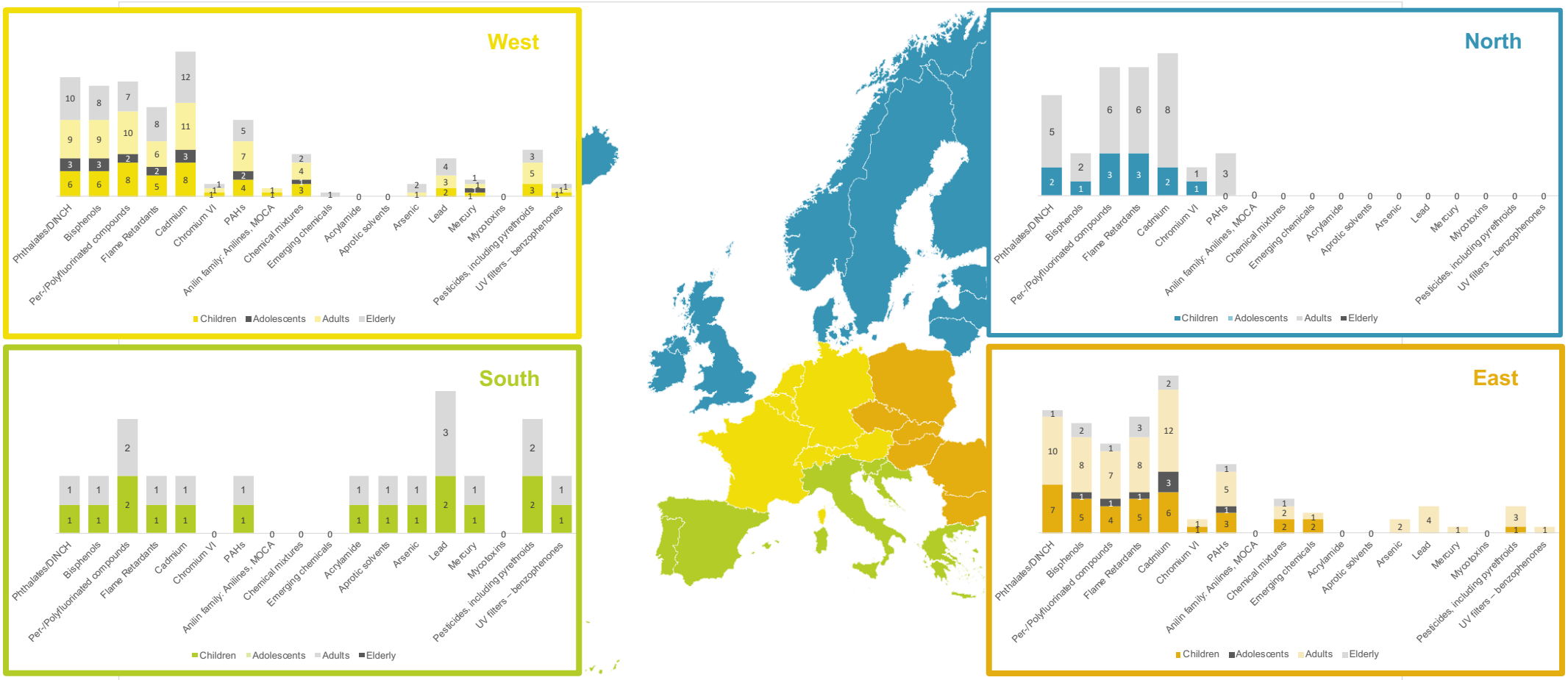


**Figure 19: Group of substances assessed in already concluded studies, by European-defined region and age group**

Note: European-defined regions:
*North*: Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
*West*: Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland
*South*: Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain
*East*: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia

Note 2: Children - 0-11 years old; Adolescents - 12-19 years old; Adults - 20-59 years old; Elderly - >59 years old

Note 3: The above age groups were grouped into four categories: Children includes “children” and “children in the mother-child pairs”; Adults include “pregnant women”, “mothers in the mother-child pairs” and “adults”

Note 4: No cases for diisocyanates

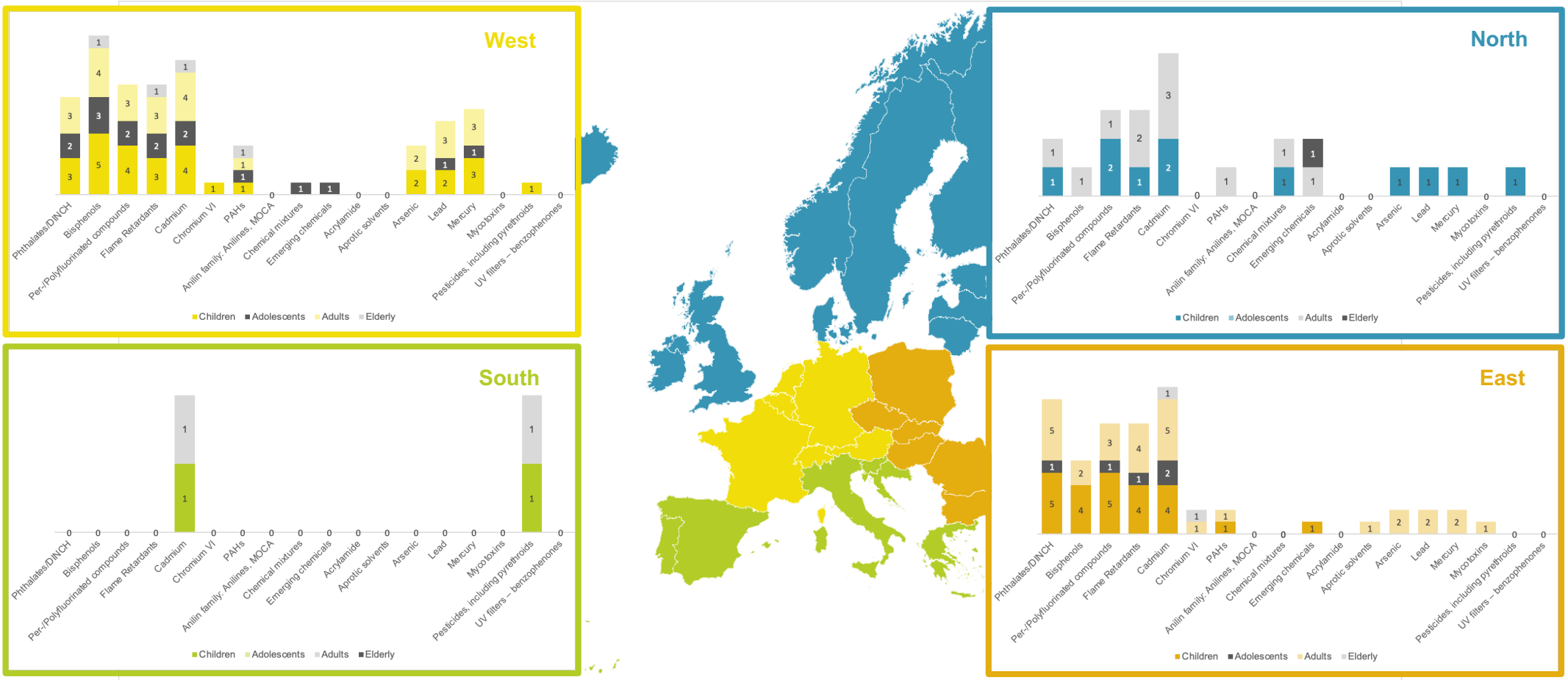


**Figure 20: Group of substances assessed in initiated/ongoing studies, by European-defined region and age group**

Note: European-defined regions:
*North*: Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
*West*: Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland
*South*: Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain
*East*: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia

Note 2: Children - 0-11 years old; Adolescents - 12-19 years old; Adults - 20-59 years old; Elderly - >59 years old

Note 3: The above age groups were grouped into four categories: Children includes “children” and “children in the mother-child pairs”; Adults include “pregnant women”, “mothers in the mother-child pairs” and “adults”

Note 4: No cases for diisocyanates

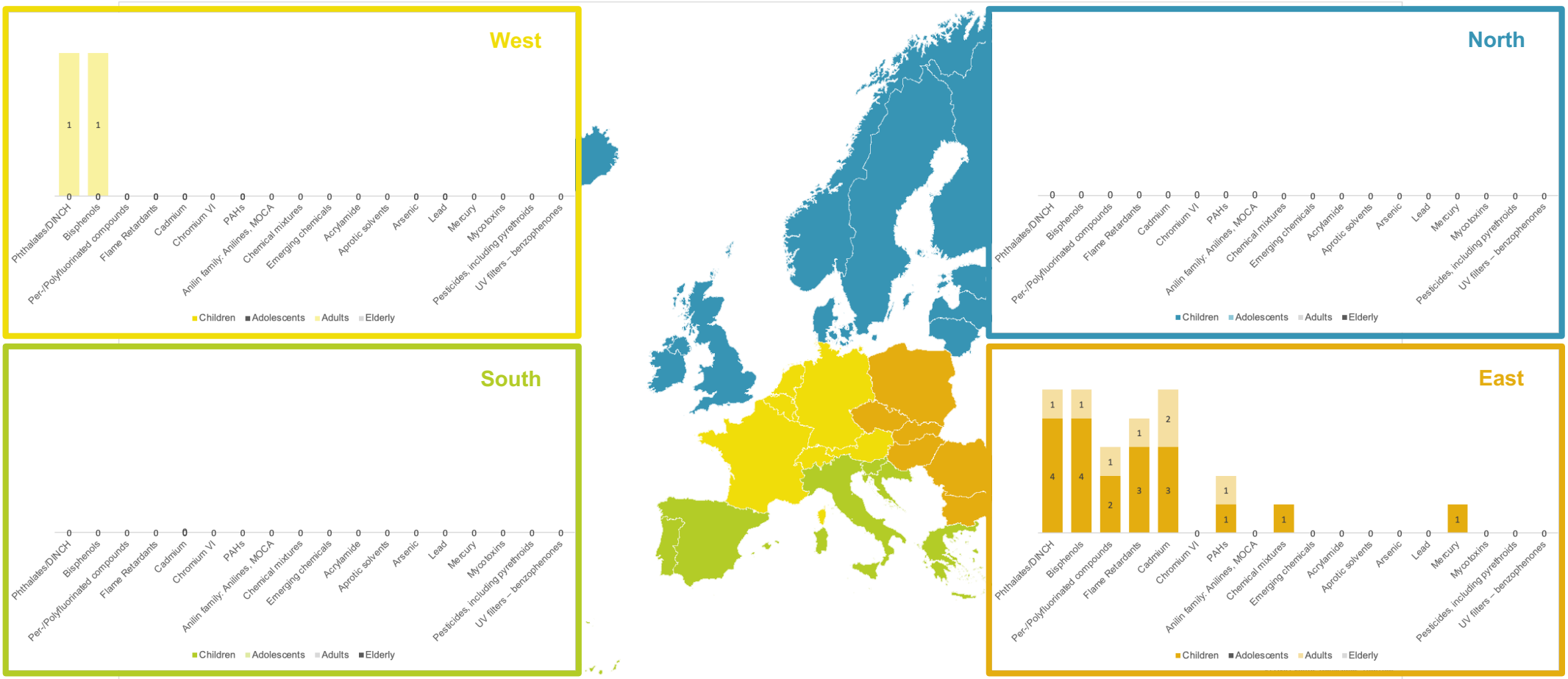


**Figure 21: Group of substances assessed in planned studies, by European-defined region and age group**

Note: European-defined regions:
*North*: Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
*West*: Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland
*South*: Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain
*East*: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia

Note 2: Children - 0-11 years old; Adolescents - 12-19 years old; Adults - 20-59 years old; Elderly - >59 years old

Note 3: The above age groups were grouped into four categories: Children includes “children” and “children in the mother-child pairs”; Adults include “pregnant women”, “mothers in the mother-child pairs” and “adults”

Note 4: No cases for diisocyanates

### 6.1.5 Biological substances collected and stored

Considering the collected biological samples, blood (including blood, blood erythrocytes, plasma and serum) was the most frequently collected sample in the reported studies, followed by urine (which includes 12-hours overnight urine samples, 24-hour urine samples, random urine spot samples and first morning urine spot samples) (Figure 22).

It is also possible to understand, from the observation of Figure 22, that cell lines, fat/adipose tissue and buccal cells were collected (each of them) in less than six studies.

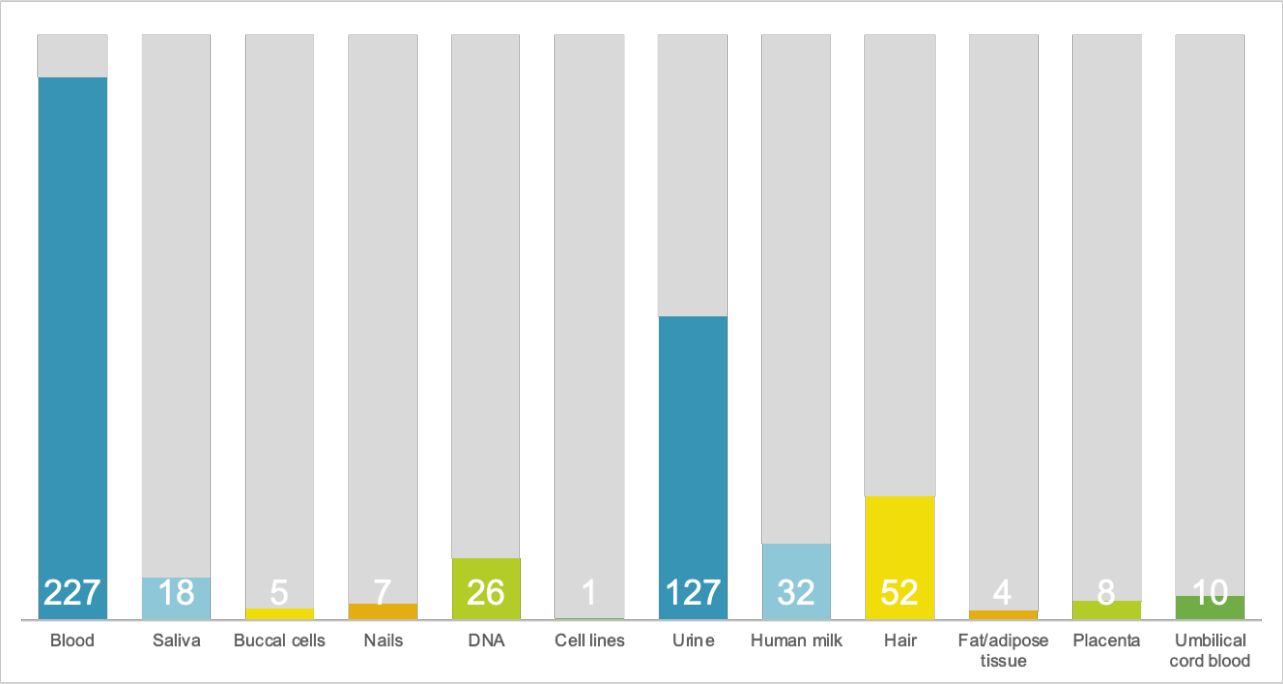


**Figure 22: Number of studies with biological samples collected**

Note 1: The blood category includes reported collected biological samples of blood (n=96), blood erythrocytes (n=16), plasma (n=53) and serum (52); the urine category includes 12-hours overnight urine (n=2), urine (24h) (n=8), urine (spot sample - random) (n=49) and urine (spot sample - first morning) (n=68); the hair category includes hair (chopped/lyophilised sample) (n=12) and hair (complete locks) (n=40); the umbilical coord blood includes umbilical cord blood - whole blood (n=9), umbilical cord blood – serum (n=0) and umbilical cord blood – plasma (n=1)

Note 2: Data presented in this table refer to a multiple-choice question. The sum of reported studies does not correspond to the total number included in the platform.

The distribution of biological samples collected in the reported studies by regions reveals that, in the north, blood (in 16 studies), first morning urine spot samples (in 14 studies), and serum and random urine spot samples (in 12 studies each) were the most frequently collected samples (Table 8). In the western region, the most commonly collected samples was also blood (in 27 studies), followed by first morning urine spot samples (in 27 studies). In the south, it was mainly blood (in 6 studies), serum (in 5 studies), plasma (in 4 studies) and first morning urine spot samples (in 4 studies). Finally, in the east, besides blood (in 40 studies), serum (in 24 studies) and first morning urine spot samples (in 20 studies) were the most frequently collected biological samples.

**Table 8: Studies by biological samples collected for each European-defined region**

| | European-defined region | | | | |
| --- | --- | --- | --- | --- | --- |
| | North n (%) | West n (%) | South n (%) | East n (%) | Other n (%) |
| **Blood** | 16 (53.3) | 27 (57.4) | 6 (60.0) | 40 (71.4) | 7 (70.0) |
| **Blood erythrocytes** | 4 (13.3) | 4 (8.5) | 1 (10.0) | 5 (8.9) | 2 (20.0) |
| **Plasma** | 8 (26.7) | 18 (38.3) | 4 (40.0) | 18 (32.1) | 5 (50.0) |
| **Serum** | 12 (40.0) | 17 (36.2) | 5 (50.0) | 24 (42.9) | 4 (40.0) |
| **Saliva** | 3 (10.0) | 4 (8.5) | 1 (10.0) | 6 (10.7) | 4 (40.0) |
| **Buccal cells** | 2 (6.7) | 1 (2.1) | - | 2 (3.6) | - |
| **Nails** | 1 (3.3) | 2 (4.3) | 1 (10.0) | 2 (3.6) | 1 (10.0) |
| **DNA** | 7 (23.3) | 8 (17.0) | 2 (20.0) | 8 (14.3) | 1 (10.0) |
| **Cell lines** | - | - | - | 1 (1.8) | - |
| **12-hours overnight urine** | 1 (3.3) | - | - | - | 1 (10.0) |
| **Urine (24h)** | 1 (3.3) | - | - | 6 (10.7) | 1 (10.0) |
| **Urine (spot sample - random)** | 12 (40.0) | 12 (25.5) | 3 (30.0) | 18 (32.1) | 4 (40.0) |
| **Urine (spot sample - first morning)** | 14 (46.7) | 27 (57.4) | 4 (40.0) | 20 (35.7) | 3 (30.0) |
| **Human milk** | 8 (26.7) | 9 (19.1) | 1 (10.0) | 13 (23.2) | 1 (10.0) |
| **Hair (chopped/lyophilised sample)** | 5 (16.7) | 3 (6.4) | 1 (10.0) | 2 (3.6) | 1 (10.0) |
| **Hair (complete locks)** | 2 (6.7) | 17 (36.2) | 2 (20.0) | 17 (30.4) | 2 (20.0) |
| **Fat/adipose tissue** | 2 (6.7) | - | - | 1 (1.8) | 1 (10.0) |
| **Placenta** | 2 (6.7) | 3 (6.4) | - | 3 (5.4) | - |
| **Umbilical cord blood - whole blood** | 1 (3.3) | 3 (6.4) | 1 (10.0) | 4 (7.1) | - |
| **Umbilical cord blood - serum** | - | - | - | - | - |
| **Umbilical cord blood - plasma** | - | - | - | 1 (1.8) | - |

Note 1: European-defined regions:
*North*: Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
*West*: Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland
*South*: Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain
*East*: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia
*Other*: Israel

Note 2: The symbol '-' is used for no cases

Analysing the distribution of collected biological samples by analysed chemical (group of) substances, it is visible that, like pointed out before, blood is the most frequently used matrix, followed by first morning, random urine spot samples and serum. Detailed information can be found in Table 9.

**Table 9: Studies that collected each type of biological sample for each group of substances**

| | Phtha-lates/ DINCH | Bisphe-nols | Per-/Poly-fluo-rinated com-pounds | Flame Retar-dants | Cad-mium | Chro-mium VI | PAHs | Anilin family: Anilines, MOCA | Chemi-cal mixtures | Emer-ging chemi-cals | Acryla-mide | Aprotic solvents | Arsenic | Lead | Mercury | Mycoto-xins | Pestici-des, inclu-ding pyre-throids | UV filters – benzo-phenones |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Blood** | 38 (69.1) | 31 (64.6) | 34 (69.4) | 27 (60.0) | 51 (68.0) | 5 (62.5) | 22 (73.3) | 1 (100.0) | 10 (76.9) | 5 (100.0) | 2 (50.0) | 1 (50.0) | 13 (81.3) | 19 (76.0) | 15 (68.2) | 2 (66.7) | 15 (68.2) | 2 (50.0) |
| **Blood erythrocytes** | 6 (10.9) | 7 (14.6) | 2 (4.1) | 6 (13.3) | 5 (6.7) | 1 (12.5) | 2 (6.7) | - | 1 (7.7) | - | - | - | 1 (6.3) | 1 (4.0) | - | 1 (33.3) | 3 (13.6) | 1 (25.0) |
| **Plasma** | 17 (30.9) | 18 (37.5) | 15 (30.6) | 15 (33.3) | 28 (37.3) | 2 (25.0) | 11 (36.7) | - | 3 (23.1) | - | - | 1 (50.0) | 6 (37.5) | 8 (32.0) | 7 (31.8) | 1 (33.3) | 6 (27.3) | 1 (25.0) |
| **Serum** | 19 (34.5) | 17 (35.4) | 14 (28.6) | 13 (28.9) | 31 (41.3) | 3 (37.5) | 12 (40.0) | - | 4 (30.8) | - | 1 (25.0) | 1 (50.0) | 8 (50.0) | 9 (36.0) | 8 (36.4) | 3 (100.0) | 9 (40.9) | 1 (25.0) |
| **Saliva** | 9 (16.4) | 7 (14.6) | 6 (12.2) | 5 (11.1) | 9 (12.0) | 2 (25.0) | 5 (16.7) | - | 2 (15.4) | 1 (20.0) | - | - | 2 (12.5) | 2 (8.0) | 3 (13.6) | 1 (33.3) | 2 (9.1) | 1 (25.0) |
| **Buccal cells** | 3 (5.5) | 3 (6.3) | 3 (6.1) | 1 (2.2) | 2 (2.7) | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Nails** | 1 (1.8) | 1 (2.1) | 2 (4.1) | 2 (4.4) | 4 (5.3) | - | 1 (3.3) | - | - | - | - | - | - | 1 (4.0) | 1 (4.5) | - | 1 (4.5) | - |
| **DNA** | 10 (18.2) | 9 (18.8) | 8 (16.3) | 10 (22.2) | 13 (17.3) | 2 (25.0) | 5 (16.7) | - | - | - | - | 1 (50.0) | 3 (18.8) | 4 (16.0) | 2 (9.1) | 1 (33.3) | 6 (27.3) | 1 (25.0) |
| **Cell lines** | 1 (1.8) | 1 (2.1) | - | 1 (2.2) | 1 (1.3) | 1 (12.5) | - | - | - | - | - | - | - | - | - | - | - | - |
| **12-hours overnight urine** | 1 (1.8) | 1 (2.1) | - | 2 (4.4) | - | - | - | - | - | - | - | - | - | - | - | 1 (33.3) | 1 (4.5) | 1 (25.0) |
| **Urine (24h)** | 4 (7.3) | 3 (6.3) | 2 (4.1) | 4 (8.9) | 3 (4.0) | - | 1 (3.3) | - | 1 (7.7) | - | - | 1 (50.0) | 1 (6.3) | 1 (4.0) | 2 (9.1) | - | - | - |
| **Urine (spot sample - random)** | 19 (34.5) | 12 (25.0) | 17 (34.7) | 12 (26.7) | 27 (36.0) | 2 (25.0) | 10 (33.3) | - | 3 (23.1) | 1 (20.0) | 2 (50.0) | 2 (100.0) | 8 (50.0) | 10 (40.0) | 8 (36.4) | 1 (33.3) | 5 (22.7) | 2 (50.0) |
| **Urine (spot sample - first morning)** | 22 (40.0) | 20 (41.7) | 21 (42.9) | 16 (35.6) | 27 (36.0) | 4 (50.0) | 12 (40.0) | 1 (100.0) | 6 (46.2) | 3 (60.0) | - | - | 3 (18.8) | 8 (32.0) | 7 (31.8) | 1 (33.3) | 10 (45.5) | 2 (50.0) |
| **Human milk** | 10 (18.2) | 9 (18.8) | 8 (16.3) | 7 (15.6) | 17 (22.7) | 2 (25.0) | 7 (23.3) | - | 3 (23.1) | 2 (40.0) | - | - | 2 (12.5) | 3 (12.0) | 1 (4.5) | - | 3 (13.6) | 1 (25.0) |
| **Hair (chopped/ lyophilised sample)** | 8 (14.5) | 5 (10.4) | 5 (10.2) | 4 (8.9) | 7 (9.3) | 1 (12.5) | 2 (6.7) | 1 (100.0) | - | - | - | - | - | 1 (4.0) | 3 (13.6) | - | 4 (18.2) | 2 (50.0) |
| **Hair (complete locks)** | 10 (18.2) | 13 (27.1) | 11 (22.4) | 9 (20.0) | 17 (22.7) | 1 (12.5) | 9 (30.0) | - | 3 (23.1) | 2 (40.0) | - | - | 2 (12.5) | 5 (20.0) | 5 (22.7) | - | 3 (13.6) | - |

| | Phtha-lates/ DINCH | Bisphe-nols | Per-/Poly-fluo-rinated com-pounds | Flame Retar-dants | Cad-mium | Chro-mium VI | PAHs | Anilin family: Anilines, MOCA | Chemi-cal mixtures | Emer-ging chemi-cals | Acryla-mide | Aprotic solvents | Arsenic | Lead | Mercury | Mycoto-xins | Pestici-des, inclu-ding pyre-throids | UV filters – benzo-phenones |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fat/adipose tissue** | 1 (1.8) | 2 (4.2) | - | 2 (4.4) | 1 (1.3) | - | - | - | - | - | - | - | 0 (0.0) | - | - | 1 (33.3) | 1 (4.5) | 1 (25.0) |
| **Placenta** | 3 (5.5) | - | 1 (2.0) | 3 (6.7) | 3 (4.0) | - | 1 (3.3) | - | 2 (15.4) | - | - | - | 1 (6.3) | 1 (4.0) | - | 0 (0.0) | - | - |
| **Umbilical cord blood - whole blood** | 5 (9.1) | 3 (6.3) | 4 (8.2) | 5 (11.1) | 6 (8.0) | - | 4 (13.3) | - | - | - | 1 (25.0) | - | 2 (12.5) | 5 (20.0) | 1 (4.5) | - | 6 (27.3) | - |
| **Umbilical cord blood - plasma** | 1 (1.8) | 1 (2.1) | 1 (2.0) | 1 (2.2) | 1 (1.3) | - | 1 (3.3) | - | - | - | 1 (25.0) | - | 1 (6.3) | 1 (4.0) | 1 (4.5) | - | 1 (4.5) | - |

Note 1: ‘Umbilical cord blood - serum’ in biological samples and ‘Diisocyanates’ for groups of substances were removed from the table since they had no cases
Note 2: The symbol ‘-‘ is used for no cases

As shown in Figure 23, almost 65% of the reported studies in the platform (99 studies out of 153) have indicated to have biobanked samples.

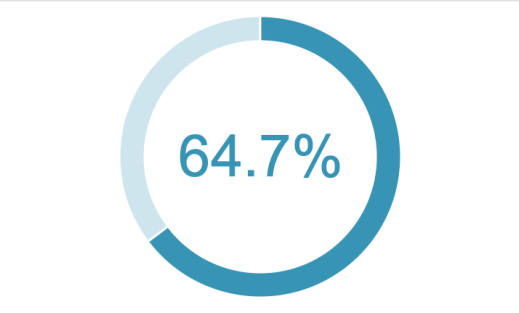


**Figure 23: Studies with biobanked samples (n=153)**

The European-defined regions having the highest number of biobanked samples are the east (with 37 studies – 37.4% of the 99 studies with biobanked samples) and the west (with 32 studies – 32.3% of the 99 studies with biobanked samples). To be noted that, for all regions, the proportion of studies with biobanked samples, out of the total number of studies, is very similar. Indeed, 60% to 70% of the studies in each region have biobanked samples (Figure 24).

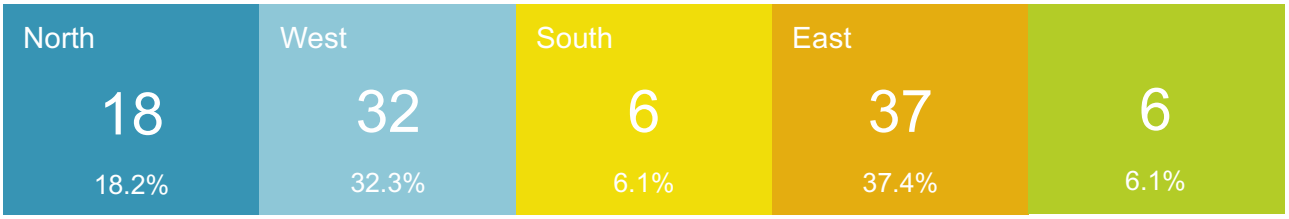


**Figure 24: Studies with biobanked samples for each European-defined region (n=99)**

Note: European-defined regions:
*North*: Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
*West*: Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland
*South*: Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain
*East*: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia
*Other*: Israel

### 6.1.6 Data access

The majority of studies allow some access and use to the biobanked samples. Of the 99 studies with biobanked samples, 38 (38.4%) allow access for other researchers/organisations but only for consultation, whereas 37 (37.4%) allow unrestricted access and use for other researchers/ organisations. Less than one quarter do not allow any access (Figure 25).

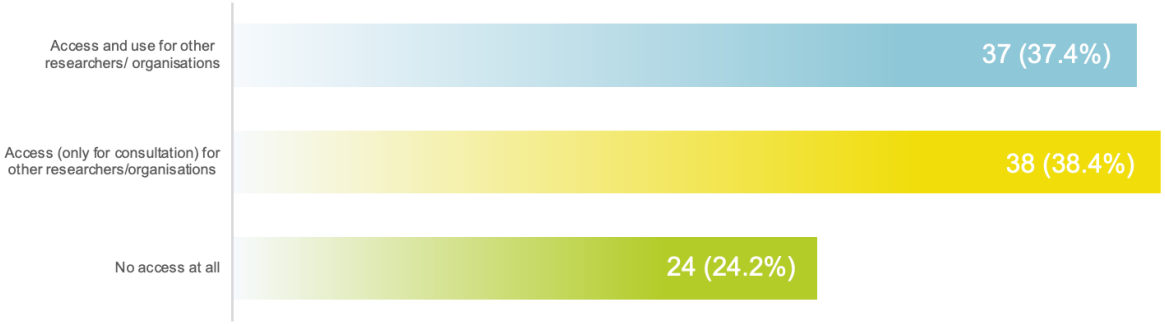


**Figure 25: Studies by type of access and use of biobanked samples (n=99)**

From the studies reported in the platform, 98 (64.5%) allow a partial access to the database and 16 (10.5%) admit an access to the total database (Figure 26).

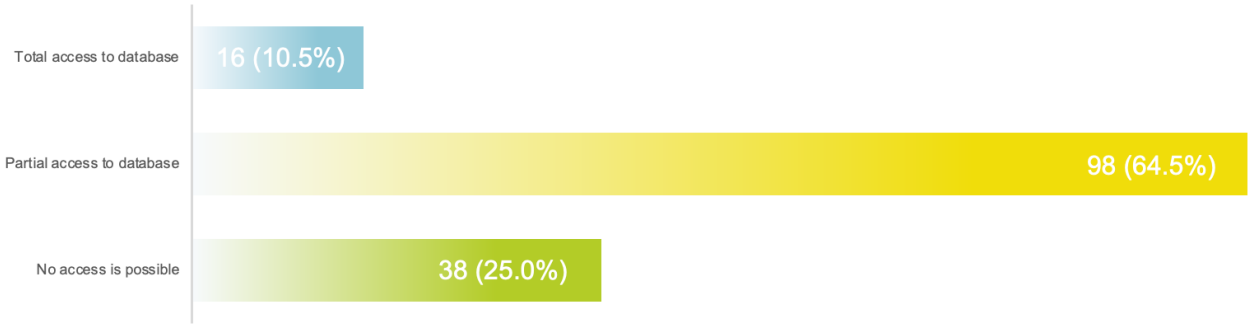


**Figure 26: Studies by type of data access (n=152)**

From the 152 studies which used a questionnaire for data collection, half (76) reported to have it available to the HBM4EU consortium partners; and nearly 35% (53) have the questionnaire available to any researcher (Figure 27).

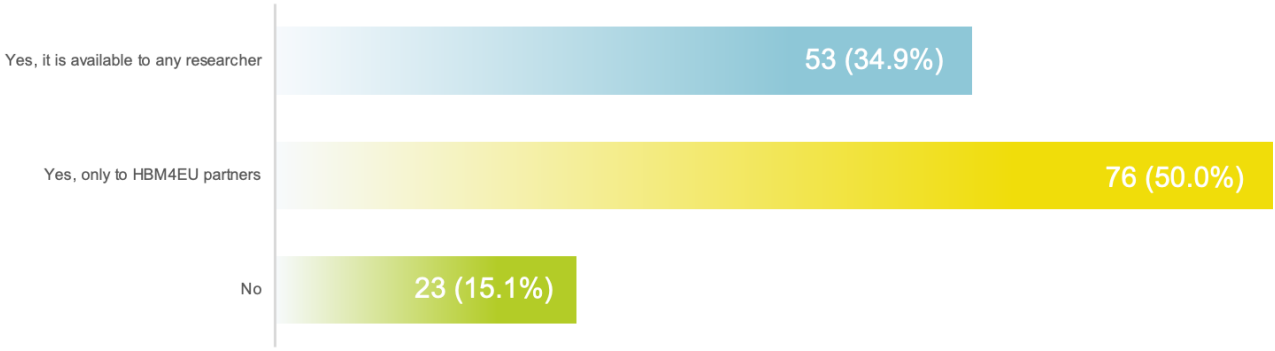


**Figure 27: Studies by type of access to the questionnaire used for data collection (n=152)**

# 7 Main conclusions

Data harmonisation is more and more a key resource to support research in several scientific areas. Towards this effort, investment has been made to gather comparable data from different studies. The difficulty, however, relies on the fact that, in most cases, the harmonisation process takes place only after data collection, integrating similar measures from different studies (retrospective harmonisation) and not during the definition of commom measures and procedures (prospective harmonisation)[6–8].

The HBM4EU initiative has been making major contributions, both at the scientific and political levels, to shape the development of HBM research. Among several endeavours, one of the focus of the project is the harmonisation of the HBM activities and procedures undertaken in the partner contries. Data harmonisation represents, in this context, an important instrument for the work that has been developed within HBM4EU as it can be used to explore or improve similiarities between different (international) studies, putting into evidence eventual data gaps, and to inform policy decisions[8]. With the aligned studies, the HBM4EU researchers have been making an effort to work on a prospective harmonisation[9]. Another effort has been made from a retrospective point of view, in terms of seeking access to comparable data which has obvious advantages in what concerns to time and funding[8].

In the past four years, the work developed within Task 7.1 has contributed to this harmonisation of procedures of the HBM4EU initiative since a first crucial step is to identify the existing data and the biological samples collected. The questionnaire created in 2017, and updated in 2018, to map concluded, ongoing and planned studies of the HBM4EU partner institutions gave way in 2019 to an online user-friendly platform always accessible to the researchers of the consortium. This is an useful resource which catalogues standard details on the reported studies, namely: i) general information of the study, ii) description of the targe population and method of selection of participants, iii) fieldwork details, iv) studied indicators (including chemical substances analysed and samples collected), v) quality control procedures, vi) data protection, availability and conditions of access and use, vii) communication procedures and viii) obstacles, shortcomings and difficulties. Attending to the comprehensiveness of the covered data, the platform can be used by researchers to identify specific studies that could be part of harmonisation procedures or to inform other WPs of the HBM4EU initiative.

So far, this tool has collected information on 153 studies with marked assymetries between the European-defined regions, with the south being the region with the lowest number of entries. Also, the reported data reflects heterogeneity regarding status, design and target population of the included studies. Concerning status, to emphasise that although the majority of the studies were concluded or ongoing, the platform has also information on a small percentage of planned studies. This is a relevant aspect given the difficulty to locate research created by other agents of knowledge production which are often not or under-reported in the scientific literature. Regarding study design, it was found that most studies follow a cross-sectional or a longitudinal design. Nonetheless, other study designs were also reported. This diversity reflects the premisse that should determine the design of any scientific study, which is the goals and hypotheses[10]. In terms of target population, it should be noted the small number of reported studies undertaken with pregnant women and elderly, though they have used, in average, the largest sample sizes, compared to the studies targeting other populations.

HBM4EU has defined, along two rounds of prioritisation, 19 chemical substances or groups of substances as relevant for research and surveys under the project. According to the studies included in the platform, almost all substances have been object of study, with the exception for diisocyanates (i.e., no studies identified this substance as object of study). There are also few

studies for the anilin family, aprotic solvents, mycotoxins, UV filters and emerging chemicals. And not surprisingly, blood and urine were the most common biological samples where these substances were analysed. To note that samples storage was performed in more than half of the studies.

Finally, since access to information is a key requirement for data harmonisation, it is a positive sign that a great part of the studies' PIs indicated that the biobanked samples, collected data and questionnaire used for data collection are possible to be accessible by other researchers; if not by the general scientific community, at least by the HBM4EU consortium members.

The conclusions drawn with this data analysis need to be considered with caution. Indeed, the mere absence of studies in some of the presented variables does not necessarily mean that no projects were undertaken. On one hand, studies could have not be reported because the PIs may have not been aware of this platform, despite the efforts done for disseminating it in each of the consortium-represented countries. On the other side, some variables considered as relevant and summarised in this report may have not been a priority for the inquired partners. Therefore, a more thorough dissemination of the platform, its functionalities and its potentials need to be done in 2021.

This platform offers an important starting point for the harmonisation procedures undertaken within the HBM4EU projects. Furthermore, from a sustainable perspective, it has the potential to inform and support future collaborative initiatives, such as the Partnership for the Assessment of Risk from Chemicals. Indeed, all of the lessons learned, the construction processes underlying the development of this platform are informative and should be considered for the development of a similar, though more completed, HBM registry.

## 7.1 Next steps

As in any other area, in the HBM field of research, the quality of the collected data is a central aspect of an identification process of existing data and data gaps. Though, the integration of data from different studies in various geographical regions is challenging as the information produced is already extensive, and data quality can be uneven. In this context, a continuous effort should be made in the direction of validation and making data uniform as much as possible to be used by others. So, all of the contributers (namely, the Principal Investigators), having provided information about their studies to this platform, will be contacted again at the beginning of 2021 and reminded of the necessity of checking and updating the reported information. All data should be collected in June 2021.

In addition, final adjustments will be made to the platform and the report functionality will be updated in order to allow more ways to visualise the data inserted in the platform.

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# 9 Appendix: Variable map

| | |
| --- | --- |
| GENERAL INFORMATION | ▪ Identification of HBM study/project/activity<br>Name<br>Acronym |
| | ▪ HBM type of study/project/activity<br>▪ Study/project/activity implementation level<br>▪ Country/countries where data were/are/will be collected<br>▪ Language of data collection<br>▪ Institution responsible for the study/project/activity implementation<br>Name<br>Acronym<br>Country<br>Sector<br>Type of institution |
| | ▪ Other institutions involved<br>▪ Principal Investigator<br>▪ Contact person<br>▪ General objectives of the study/project/activity<br>Main goals of the study/project/activity<br>HBM specific related-objectives of the study/project/activity |
| | ▪ Status of the study/project/activity<br>▪ Beginning (or previewed starting) of the study/project/activity<br>▪ (Previewed) Ending date of the study/project/activity |
| | ▪ Budget of the project/study/activity<br>▪ Funding Institutions<br>▪ Ethical approval<br>By whom<br>Information of the contact person for ethic documents<br>▪ Internet link with information about data collection tools |

**TARGET POPULATION AND METHOD OF SELECTION OF PARTICIPANTS**

- Study design
- Time schedule (frequency) of this study/project/activity
- Study setting
- Type of target population
- Target groups and respective sample size(s)
  - Children (0-11 years old)
    - *Lower limit*
    - *Upper limit*
    - *Sample size*
  - Adolescents (12-19 years old)
    - *Lower limit*
    - *Upper limit*
    - *Sample size*
  - Pregnant women
    - *Lower limit*
    - *Upper limit*
    - *Sample size*
  - Mother-child pairs
    - *Mother's age lower limit*
    - *Mother's age upper limit*
    - *Child's age lower limit*
    - *Child's age upper limit*
    - *Child's sex*
    - *Number of mothers*
    - *Number of pairs*
  - Adults (20-59 years old)
    - *Lower limit*
    - *Upper limit*
    - *Sample size*
  - Elderly (>59 years-old)
    - *Lower limit*
    - *Upper limit*
    - *Sample size*
- Who participated
- Inclusion criteria

- Sex
- Age
- Geographical units (e.g., NUTS II)
- Health condition
- Specific exposure
- Other inclusion criteria

- Exclusion criteria
  - Sex
  - Age
  - Geographical units (e.g., NUTS II)
  - Health condition
  - Specific exposure
  - Other inclusion criteria
- Control/reference group
  - Size of the control/reference group
- Sampling method
- Description of the sampling scheme
  - Sampling units
  - Stratification
  - Procedure
  - Other information
- Sample's representativeness (regarding any kind of universe/population)
- Recruitment/sampling frame (origin of participant addresses)
- Recruitment method (first individual contact)
- Individual recruitment procedure
  - Type of the first contact
  - Invitation letter
  - Number of reminders/recontacts
  - Type of reminders/recontacts
  - Confirmation letter
  - Sending of sample vessels
  - Personal visit for interview
- Consent procedures
  - Type of consent form

- Participants' information about the aims and/or methodologies of the study/project/activity
  - In what way were participants informed?
- Scope of the informed consent
- Incentives for participants / Methods to raise participation rate

**FIELDWORK**

- Period of data collection
  - Beginning date
  - Ending date
- Mode of questionnaire administration
  - Information obtained by qualified and trained personnel (for face-to-face or telephone interviews)
  - Place of interview conduction (for face-to-face interviews)
- Possibility to share questionnaire
- Biological samples collected
- Groups of substances under study
- Collection of genetic related data
  - Data collected regarding specific polymorphisms
  - Other genetic-related data collected
- Collection of molecular (or omics) information data
- Collection of data about skin parameters
  - Data collected regarding skin parameters
- Collection of data about respiratory/lung parameters
  - Data collected regarding respiratory/lung parameters
- Collection of data about skeletal parameters
  - Data collected regarding skeletal parameters
- Collection of data regarding renal function parameters
  - Data collected regarding renal function parameters
- Collection of data regarding reproductive and/or development system parameters
  - Data collected regarding pregnancy and lactation
  - Data collected regarding the newborn
  - Data collected regarding sexual maturation and function
  - Data collected regarding development

- Collection of data regarding immunity
  - Data collected regarding immunity
- Collection of data regarding neurological parameters
  - Data collected regarding morphology
  - Data collected regarding behavioural and other neurological assessments
- Collection of anthropometric / body composition data (not subjective data but objectively measured)
  - Data collected regarding anthropometry / body composition
- Collection of data regarding essential trace elements
  - Data collected regarding essential trace elements
- Collection of data regarding other parameters or physiological indicators
  - Data collected regarding other parameters or physiological indicators

**OTHER DATA**

- Collection of data about outdoor pollution
  - Data collected regarding air pollutants
  - Data collected regarding biological pollutants
  - Data collected regarding soil pollution
  - Data collected regarding the ratio of heavy metals
  - Data collected about environmental noise exposure
- Collection of data about climate and/or meteorological variables
  - Data collected regarding outdoor climate and/or meteorological variables
- Collection of general information on residence
  - Data collected regarding general information on residence
- Collection of data about indoor variables
  - Data collected about housing characteristics
  - Data collected regarding household drinking water characteristics
  - Data collected regarding household air quality
  - Data collected regarding house dust
- Collection of data about food intake / food habits
  - Food habits' assessment method applied
  - Data collected about consumption of food produced locally
- Collection of data about traffic exposure or mobility

Data collected regarding about traffic exposure or mobility

- Collection of data about participants' personal hygiene

Data collected regarding the participants' personal hygiene

- Collection of data about smoking habits

Data collected about smokers

Data collected about nonsmokers

*Data collected regarding passive smoking*

- Collection of data about dental status

Data collected regarding teeth decay's prevention or treatment

- Collection of data about clothing / body adornments

Data collected regarding clothing / body adornments

- Collection of data about contact with toxic substances

Data collected regarding contact with toxic substances

- Collection of data about hobbies and holidays

Data collected regarding hobbies and holidays

- Collection of data about other lifestyle aspects

Data collected regarding other lifestyle aspects

- Collection of data about health care utilization

Data collected regarding health care utilization

- Collection of data about family health-related history

Family members with data collection about

Data collection about other family members' health-related history

*Regarding other family members' health-related history, which information were / will be collected?*

- Collection of data about medical history of the participant

Information collected regarding participants' health-related history

- Collection of data about specific stages of life

Data collected regarding specific stages of life

- Collection of data about pregnancy or delivery

Data collected regarding pregnancy or delivery

- Collection of data about newborn / infant biometry/health

Data collected regarding newborn/infant biometry/health

- Collection of data about unspecified health complaints

Data collected regarding unspecified health complaints

- Collection of data about accidents

Data collected regarding accidents

- Collection of data about medication during the perinatal period

Data collected regarding medication during the perinatal period

- Collection of data about medication administered to or taken by children or adolescents

Data collected regarding medication administered to or taken by children or adolescents

- Collection of data about permanent or acute medication for respiratory or allergic diseases

Data collected regarding permanent or acute medication for respiratory or allergic diseases

- Collection of data about exposure during pregnancy and/or breastfeeding

Data collected regarding the periconceptional period

Data collected regarding pregnancy and delivery

Data collected regarding breastfeeding

- Collection of data about occupational exposure
- Collection of data about other types of exposure

Data collected regarding other types of exposure

- Collection of data about socio-demographic and/or socio-economic factors

Data collected regarding general socio-demographics

Data collected regarding family structure

Data collected regarding employment status and income

Data collected regarding education

Data collected regarding other socio-demographic and/or socio-economic factors

- Other Data

**QUALITY CONTROL PROCEDURES**

- Preanalytical Quality Assurance/Quality Control (QA/QC)
- Identification of critical phases
- Quality control procedures

Quality control procedures - Internal quality control procedures

Quality control procedures - Standard operating procedures

- Quality control programs
- National external Quality Assessment Schemes - Accreditation

Type of accreditation for the laboratory

- National external Quality Assessment Schemes Certification
- Other external quality assessment schemes

**DATA PROTECTION, AVAILABILITY AND CONDITIONS OF ACCESS AND USE**

- Nature of personal data
- Moments of personal data protection

Methods of data protection at the time of collection

Methods of data protection during storage

*Database protection regulation*

*Moment of data destruction*

- Intellectual property rights
- Data access

Direct online access

By request

- Existence of biobanked samples

Type of biological samples / matrix

Data management for continuous documentation of withdrawal/adding of samples from/to the biobank

*Commercial data management system used*

Access and use of biobanked samples

- Access to analytical standards to detect biomarkers

**COMMUNICATION**

- Reporting results to Public Authority

Public Autority(ies) for reporting of results

Ways of report of results to public authorities

- Reporting results to study participants

Ways of report of results to study's participants

- Reporting results to Health Institutions

Health Institutions for reporting of results

Ways of report of results to health institutions

- Reporting results to scientific community

Ways of report of results to the scientific community

*Please indicate the report form where the results were reported*

Relevant publications

- Reporting results to general public

Ways of report of results to the general public

- Occasional symposia part 1
- Occasional symposia part 2 Debates between different stakeholders
- Occasional symposia part 3 Media
- Consequences of external communication
- Examples of material used to communicate with the study participants

**OBSTACLES, SHORTCOMINGS AND DIFFICULTIES**

- General constraints and difficulties
- Difficulties in samples collection

Blood samples

Fat samples

Physical examinations

- Difficulties in the collection of other type of samples

Other type of samples where difficulties were found

Difficulties found in the collection of other type of samples

- Difficulties in recruitment of participants

Low participation level

Low response rate

- Strategies relevant for increasing response rate

Recruitment bias

- Other identified problems

Problems with logistics

Problems with team leadership

Problems with logistics

**ADDITIONAL INFORMATION**