

## PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (<http://bmjopen.bmj.com/site/about/resources/checklist.pdf>) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

### ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	BlueHealth: a study programme protocol for mapping and quantifying the potential benefits to public health and well-being from Europe's blue spaces
<b>AUTHORS</b>	Grellier, James; White, Mathew; Albin, Maria; Bell, Simon; Elliott, Lewis; Gascón, Mireia; Gualdi, Silvio; Mancini, Laura; Nieuwenhuijsen, Mark; Sarigiannis, Denis; van den Bosch, Matilda; Wolf, Tanja; Wuijts, Susanne; Fleming, Lora

### VERSION 1 - REVIEW

<b>REVIEWER</b>	Chinmoy Sarkar The University of Hong Kong Hong Kong
<b>REVIEW RETURNED</b>	15-Feb-2017

<b>GENERAL COMMENTS</b>	<p>The authors present a concise and systematic study protocol for BlueHealth. The importance of BlueHealth is highly relevant in the present context; especially those related to environmental factors (multi-fold urban expansion and climate change) as well as population level health (sedentary lifestyles and related chronic diseases). Incorporating 'BlueHealth' within our environmental, urban and public health decision-making tree and policy can help minimize/offset a significant amount of future health expenditures. This study presents a protocol to measure and monitor BlueHealth, retrofit preventive urban interventions and measure associated changes in behavioural and mental health indicators for a very large, spatially diverse EU-wide population. It involves the application of diverse sets of tools and instruments for objectively mapping and measurement of various attributes of BlueHealth and related health indicators.</p> <p>I suggest the following very minor points:</p> <p>1) Secondary data analyses (pg. 11): The authors mention about multiple indicators of mental health outcomes derived from health surveys in participating countries.</p> <ul style="list-style-type: none"><li>- A mention about an indicative figure for the targeted N; study sample for each of these participating countries (UK, Catalunya and Skane regions) will help the readers learn about the scale?</li><li>- A mention about the spatial scale at which exposure to blue spaces will be assessed will help (for example will it be street distance of geocoded participants' residence to nearest blue space or average exposures at ward-level or related census geographies).</li></ul> <p>BlueHealth International Survey (pg. 11): A mention about the participant sample size in each country will help convey the scale.</p> <p>2) Discussion:</p> <p>BlueHealth Decision Support tool (DST): This is a valuable tool guiding future blue allocation, planning and policy. So a couple of sentences on the potential of the developed DST in scenario</p>
-------------------------	---

	generations: blue allocation based on vulnerability assessment (obesogenic environments, stressful environments), retrofitting designs of existing ones and assessing transformability potential (as future negative externalities may originate from changes in aquatic species, infectious disease vectors; flood hazards; eutrophication and terrestrialization) will help.
--	--

<b>REVIEWER</b>	Catarina Patoilo Teixeira University of Porto, Portugal
<b>REVIEW RETURNED</b>	19-Feb-2017

<b>GENERAL COMMENTS</b>	<p>The article is well-written and presents the objectives of the study in a clear and concise way. The study has an innovative and interdisciplinary character and its importance for the future is well argued throughout the text. The study also shows an enormous potential to enrich and to develop the knowledge linked to “blue space”, especially regarding its benefits.</p> <p>The inclusion of novel tools such as VR, reflects the strong ethical concern of the study, as it tries to reach and deliver health improvements to a vast number of people.</p> <p>It would be interesting to develop the definition of the concept «blue spaces». And it would also be helpful to briefly clarify how the 13 community-level interventions (CLIs) were selected for the study. Based on which criteria?</p>
-------------------------	--

## VERSION 1 – AUTHOR RESPONSE

### RESPONSE TO REVIEWERS

Layout of this document

-----

|| Reviewer comments are preceded by a double vertical bar ||.

{ Our authors’ responses to comments preceded by an open curly bracket {.

[ Specific changes made to wording or additions made to the manuscript in response to comments of the reviewers are indented and preceded by an open square bracket [.

#### 1.0 Response to Reviewer 1

-----

Reviewer Name: Chinmoy Sarkar

Institution and Country: The University of Hong Kong, Hong Kong

Please state any competing interests or state ‘None declared’: None

#### 1.1 General comments

-----

|| The authors present a concise and systematic study protocol for BlueHealth. The importance of BlueHealth is highly relevant in the present context; especially those related to environmental factors (multi-fold urban expansion and climate change) as well as population level health (sedentary lifestyles and related chronic diseases). Incorporating ‘BlueHealth’ within our environmental, urban and public health decision-making tree and policy can help minimize/offset a significant amount of future health expenditures.

This study presents a protocol to measure and monitor BlueHealth, retrofit preventive urban interventions and measure associated changes in behavioural and mental health indicators for a very

large, spatially diverse EU-wide population. It involves the application of diverse sets of tools and instruments for objectively mapping and measurement of various attributes of BlueHealth and related health indicators.

{ We are very pleased that the reviewer recognises the importance of this work, not least from the perspective of how it aims to influence policy-making and the inclusion of health as a co-benefit of decisions made in a variety of sectors, using a broad range of tools.

## 1.2 Specific comments

-----  
|| I suggest the following very minor points:

1) Secondary data analyses (pg. 11): The authors mention about multiple indicators of mental health outcomes derived from health surveys in participating countries.

- A mention about an indicative figure for the targeted N; study sample for each of these participating countries (UK, Catalunya and Skane regions) will help the readers learn about the scale?

{ We agree with the reviewer that this information is of value to the reader and better conveys the correct impression of scale of these data. We have now added information on the sizes of each survey to the manuscript as follows:

[ We will conduct coordinated research on key European datasets that contain common health outcomes (e.g. GHQ12,[71] SF-36,[72] Global Life Satisfaction[73]), allowing for consistent operationalisation of exposure to blue space (i.e. residential proximity), including the UK Understanding Society survey (~40000 subjects per two-year wave),[74] the Enquesta de Salut de Catalunya ('Health Survey of Catalonia') (~8 000 subjects per four-year sample),[75] and the Swedish Skåne Public Health Questionnaire (~28 000 subjects per four-year wave).[76]

{ It is important to note, however, that the sample sizes of these studies should not be interpreted as the sample sizes that will ultimately be used in the BlueHealth secondary data analyses, as indices of exposure to blue space will be assigned using data from the Urban Atlas, which covers "most EU28 cities over 50,000 inhabitants" . The precise numbers of each survey that can be linked to Urban Atlas environmental data at this stage are not known as validated 2012 data sets are yet to be released. Since the majority of populations of all three countries live in urban areas we anticipate that the sample sizes will be relatively consistent with the cited numbers.

|| - A mention about the spatial scale at which exposure to blue spaces will be assessed will help (for example will it be street distance of geocoded participants' residence to nearest blue space or average exposures at ward-level or related census geographies).

{ We thank the reviewer for this suggestion and concur that this information will better explain the nature of our assignment of exposure to study subjects. We have added this to the text as follows.

[ Survey responses will be geocoded as population-weighted centroids of lower layer super output areas (UK), and residential address (Sweden and Catalonia); various metrics of residential proximity to blue space (based on previous research[44,56]) and area-level average exposures will be assigned using the European Environment Agency's Urban Atlas.[77]

|| BlueHealth International Survey (pg. 11): A mention about the participant sample size in each country will help convey the scale.

{ We have now added a sentence to explain the sizes of the participant sample size in each country:

[ One thousand panel members will be surveyed in each country (except in Bulgaria and Estonia,

where 500 individuals will be surveyed).

## 2) Discussion:

|| BlueHealth Decision Support tool (DST): This is a valuable tool guiding future blue allocation, planning and policy. So a couple of sentences on the potential of the developed DST in scenario generations: blue allocation based on vulnerability assessment (obesogenic environments, stressful environments), retrofitting designs of existing ones and assessing transformability potential (as future negative externalities may originate from changes in aquatic species, infectious disease vectors; flood hazards; eutrophication and terrestrialization) will help.

{ In terms of the potential of the DST to scenario generation, we have added the following text:

[ Depending on how the BlueHealth DST is developed—which will in large part be based on stakeholder needs identified—this tool could be applied to assess the public health impact of various scenarios concerning changes in infrastructure, climate or other drivers.

{ We agree that the DST—depending on how it is developed in collaboration with stakeholders—could potentially be used to specifically plan interventions in blue space target areas based on an assessment of the vulnerabilities of particular populations.

The use of the BlueHealth DST to assess transformability potential of existing infrastructure was not something that we had explicitly considered previously, and thank the reviewer for this useful suggestion. The final form of the DST will depend on the outputs of our ongoing interactions with a variety of stakeholders and the outputs of other aspects of the project (the results of primary and secondary data analyses, in particular), but we agree that the assessment of transformability potential should be included as a potential application. We have added the following text to describe this:

[ Considered application of such a tool might be useful in the targeted planning of blue space infrastructure to minimise health inequalities in areas characterised by particular vulnerabilities, including assessing the transformability potential of aspects of urban environments.

## 2.0 Response to Reviewer 2

-----  
Reviewer Name: Catarina Patoilo Teixeira

Institution and Country: University of Porto, Portugal

Please state any competing interests or state 'None declared': None declared

## 2.1 General comments

-----  
|| The article is well-written and presents the objectives of the study in a clear and concise way. The study has an innovative and interdisciplinary character and its importance for the future is well argued throughout the text. The study also shows an enormous potential to enrich and to develop the knowledge linked to “blue space”, especially regarding its benefits.

|| The inclusion of novel tools such as VR, reflects the strong ethical concern of the study, as it tries to reach and deliver health improvements to a vast number of people.

{ We are glad to see that the potential importance of this study comes across clearly in the manuscript. We are also heartened to see that the reviewer has grasped the potential value of novel tools such as VR in bringing the potential benefits of exposure to blue spaces to a variety of populations with limited access to outdoor environments.

## 2.2 Specific comments

-----  
|| It would be interesting to develop the definition of the concept «blue spaces».

{ We thank the reviewer for pointing out this omission and agree that our working definition of blue space should be included in this manuscript. It has been included as follows:

[ Within the scope of BlueHealth we define blue spaces as outdoor environments—either natural or manmade—that prominently feature water and are accessible to humans either proximally (being in, on, or near water) or distally/virtually (being able to see, hear or otherwise sense water).

|| And it would also be helpful to briefly clarify how the 13 community-level interventions (CLIs) were selected for the study. Based on which criteria?

{ The rationale behind our selection of the community-level interventions was to capture the cross-cutting factors illustrated in the BlueHealth conceptual model. In selecting interventions in a range of settings—and at different scales—in European countries with a wide geographical distribution, we incorporate differences in demographics, socioeconomic status, historical, cultural and regional aspects, as well as variation in weather. In making our selection we also sought to include interventions that relate to different blue spaces (coasts, rivers, lakes etc.) affording different activities, experiences, and potential effects on health and wellbeing. In addition, we had to make these choices within the practical limits imposed by the funding available and the partner institutions working in the project consortium. We have explained this briefly by adapting the existing text and adding additional explanation:

[ At the local scale, we will evaluate impacts on health and well-being of changes to blue infrastructure and recreational behaviour in a range of community-level interventions (CLIs). Conducted across eight European countries, these CLIs were selected to encompass a variety of blue spaces (e.g. coast, rivers, lakes) and a broad range of demographic, socioeconomic, historical/cultural/regional and climatic contexts (Table 1).

#### VERSION 2 – REVIEW

<b>REVIEWER</b>	Chinmoy Sarkar Healthy High Density Cities Lab., HKUrbanLab, The University of Hong Kong.
<b>REVIEW RETURNED</b>	24-Mar-2017

<b>GENERAL COMMENTS</b>	The authors have now adequately responded to all of my queries and clarifications and I recommend this paper to be accepted.
-------------------------	--