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# EVALUATING POPULATION HEALTH: THE SELECTION OF MAIN DIMENSIONS AND INDICATORS THROUGH A PARTICIPATORY APPROACH

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## Abstract

Population health is influenced by complex interactions between multiple determinants, but there are still large gaps in knowledge about how to comprehensively evaluate the impact of these factors on health. This paper presents the participatory approach used to select a comprehensive set of dimensions and indicators to integrate the Population Health Index; a holistic measure aimed to evaluate the health of the Portuguese population over the past 20 years. It considers the multiple dimensions of population health and experts' judgements from different knowledge areas. Using a combination of Delphi method in two successive processes of consultation and nominal group review, it was reached a consensus on 62 indicators considered relevant for evaluating population health. The main dimensions were Economic and Social, Physical Environment, Healthcare Services, Lifestyles, Mortality and Morbidity. The results of the participatory approach reflects the diversity of points of view and emphasizes the holistic and multidimensional character of health.

***Keywords:*** *Health Determinants, Health Outcomes, Population Health Index, Participatory Approach, Portugal*

## 1. INTRODUCTION

Despite the substantial health gains obtained in recent years throughout all countries of the European Union (EU), clear disparities continue to exist between different regions and socioeconomic groups within the same country (Mackenbach et al., 2003). Tackling these inequities is one of the greatest challenges facing public health administrations (Blas & Kurup, 2010; Perelman et al., 2010) particularly in the present context of economic and financial crisis, where public resources are under additional strain and there is a need for adequate decision-making processes that assure maximum value for money. Thus, policies able to address the determinants of health inequities include actions within the health sector, though they are largely to be found outside it. An adequate approach to health variations demands actions directed at their causes (Dahlgren & Whitehead, 2007; Marmot et al., 2008).

Therefore, the following formulation should be considered first: What factors influence population health? Health is strongly influenced by the actions of individuals, governments, institutions and society (Santana, 2002), resulting from a multiplicity of factors corresponding to various areas of collective and individual life.

The evidence that health inequities have a strong spatial dimension is well established, with a growing understanding of the role that "place" plays in population health. Living in a given place and community interferes, positively or negatively, with individuals' behaviors and choices regarding to housing, work and social interactions, as well as lifestyle and eating habits (Dahlgren & Whitehead, 2007). The links between health and place are often indirect and complex. Many authors have conducted research using a wide range of indicators that are identified as social determinants of health and described as "the causes of the causes" (Marmot, 2005; Lalonde, 1974; Braveman et al., 2011). They are the social, economic and environmental conditions that influence health, including: characteristics of communities and neighbourhood context (Wilson et al., 2010), education levels (Ferreira & Santana, 2006), income (Lynch et al., 1998; Benzeval et al., 2001), family context and circumstances of birth (Power, 1998), socioeconomic status (Bosma et al., 2001; Santana, 2002; Macintyre et al., 2003) and even type of housing (Hood, 2005).

Most of the studies only take into account a limited number of health determinants and indicators or proxies that are able to express health outcomes, being inadequate to build a comprehensive approach able to provide us a holistic view of the population health. Furthermore, most of the instruments only measure deviations relative to a self-assessed health status or supply concrete facts in the form of mortality or morbidity figures (Bowling, 1995). There is a methodological gap concerning how to evaluate population health, integrating the interactions between all the dimensions and criteria. More valid, comprehensive and standardized measures are needed to increase comparability. Such metrics have to be connected to a clear conceptual framework, integrating relationships between different health determinants and health outcomes (Kindig & Stoddart, 2003). Furthermore, it is essential to clearly define the indicators that can offer an understanding of reality in terms of population health and its relation to risk factors. This challenge requires multidisciplinary scientific responses that go beyond the exclusively medical approach to health, bringing geographical, economic and sociological knowledge (Santana, 2005).

In Portugal, the first study to assess population health status included only morbidity-related indicators (Giraldes, 1978). Later, at the start of 1990s, was developed the first multidimensional approach to population health (Vaz et al, 1994). This model was applied, some years later, to identify health spatial variations in mainland Portugal. Under a multi-attributive utility model (MAU) 51 indicators (health determinants and health outcomes) were evaluated, considered to be directly or indirectly related to population health. This research demonstrated a clear relationship between population health and geographical

location. Despite the overall improvement of health status scores in all municipalities over the decade 1991-2001 (more evident in rural municipalities, resulting from a greater improvement in social and economic determinants), the highest-scoring municipalities (best population health) continued to be those located in the western coastal strip, corresponding to more urbanized territories. Those with lower scores (worst population health) continued to be mainly rural municipalities located further inland (Santana et al., 2002).

Although this model formed the starting point for a call to action, there are still constraints on turning evidence into policy, particularly political will remains a key barrier to translating knowledge into action. There were also some methodological aspects regarding the model construction process that needed to be improved to guarantee the quality of the final evaluation model. Consequently, in 2012, a team of researchers, including those involved in the previous model, started the research project Geography of Health Status - An application of the Population Health Index in the last 20 years (GeoHealthS), which aims to address the challenge of constructing an innovative measure, which not only evaluates population health in a holistic, multidimensional and disaggregated way, involving key stakeholders (including policy-makers) and experts' judgments, but also provides evidence about population health trends and which priority areas need to be addressed, in each municipality. The construction of this consistent measure started with the identification and selection of a comprehensive set of dimensions and indicators to integrate the Population Health Index (PHI).

## 2. AIM

The main purpose of the present paper is to describe the process of selecting the set of dimensions and indicators relevant to integrate the PHI: a holistic measure aimed to evaluate the health of the Portuguese population over the past 20 years. Additionally it intends to provide evidence about the multidimensionality of population health evaluation, demonstrating the diversity of points of view of a panel of experts from different knowledge areas.

## 3. METHODOLOGY

Considering the complex and multidimensional nature of health, the main assumption was to consider not only different dimensions and indicators of health determinants and health outcomes, but also stakeholders from different knowledge areas to make sure that the assessment allows all points of view to be aired. In a previous phase, a literature review was undertaken resulting on the identification of 177 indicators (initial list) that were grouped into 26 dimensions, according to whether they were measures of (i) health determinants or (ii) health outcomes.

Then, the Delphi method (Landeta, 2006; Linstone et al., 1975), in two successive processes of consultation, was applied to obtain the expert's opinion and facilitate consensus on the dimensions and indicators relevant for evaluating population health. In the end, to validate and ensure that, as a set, the indicators were consistent, it was used a nominal group technique [Bartunek et al., 1984]).

### 3.1. Delphi panel and nominal group

For the Delphi processes, the panel of experts was set up, consisting of 26 experts from different knowledge areas:
i) Portuguese researchers from different fields of expertise: geography, territory planning and environment (n=6), economy (n=6), epidemiology and medicine (n=4) and,

ii) Representatives from national institutions with responsibilities in the main areas whose policies have an impact on population health: Portuguese Environment Agency (n=1), Central Administration of the Health System (n=1), National Health Institute Doutor Ricardo Jorge (n=1) and from five Regional Health Administrations (n=7).
In order to facilitate analysis of the different points of view, the panel was divided into four groups, according to knowledge area: Public Health (n=7), Physicians (n=4), Healthcare Management and Economics (n=6), Environment (n=4) and Territory (n=4).
The nominal group consisted of 4 members of the research team and 2 consultant researchers of the project.

### 3.2. Delphi processes and nominal group review

To select the set of dimensions and indicators relevant for the evaluation of population health, it was employed the Delphi method, through two processes of consultation. All the indicators were formatted into a questionnaire that could be completed and returned electronically, by email.

In the first Delphi process of consultation, 1st round, the participants were asked to indicate their agreement or disagreement with each indicator proposed in the initial list by i) excluding indicators, on the grounds that were redundant, unnecessary, useless or meaningless and ii) suggesting indicators to be included, on the grounds that were necessary, indispensable or preferable (to one that they wish to eliminate) providing a short justification supported by the literature, where possible. As the selecting criteria was related with the scientific relevance of the indicator, experts were provided with literature evidence about each indicator and asked not to limit their views about the potential usefulness of an indicator for the evaluation of population health by perceived constraints on the quality of data, namely collecting or processing the data. Responses were collected from the total number of experts (n=26) between 4 and 18 April 2012.

In the second Delphi process of consultation, consisting on two rounds, the experts indicated their agreement or disagreement with each indicator by excluding indicators. The selecting criteria were mainly related with the quality of data, such as availability, validity and comparability on the desired spatial and temporal scales: at municipality level and data from the years 1991, 2001 and 2011. To support the analysis of the indicators obtained in the first Delphi process, experts had access to informative sheets with metadata relative to indicator definition, calculation, unit of measure, source of information and data availability (geographical and temporal scales). Responses for the 1st round were collected from the experts (n=26) between 19 and 27 April 2012. The 2nd round was conducted between 8 and 18 May 2012, with all experts (n=26) to whom was given the opportunity to revise their answers, considering the same selecting criteria (quality of data).

Given the multidimensionality of population health evaluation, different and sometimes conflictive points of view emerged along the process, reflecting the different knowledge areas and expertise. Empirical density functions were designed in order to check the general dispersion, concentration and symmetry of points of view. A non-linear correlation matrix was also calculated (using Spearman's coefficient), in order to obtain a multivariate analysis of the joint variations of the points of view of the different groups according to their knowledge area.

Based on the feedback from the Delphi processes of consultation, the nominal group reviewed the list of selected indicators, adjusting the final composition to ensure that the set of indicators conformed the selecting criteria and predefined objectives of the PHI. Regarding the index structure, the selected indicators were grouped in 6 main dimensions, each corresponding to a different area of concern for population health.

## 4. RESULTS

Using a combination of Delphi consultation processes and nominal group review, it was selected a set of core indicators, which a consensus of experts from different knowledge areas considers to be relevant to evaluate Portuguese population health in the last 20 years, at municipality level. After review, the nominal group endorsed the final list of 62 indicators (41 Health Determinants and 21 Health Outcomes), grouped in 6 dimensions, each corresponding to a different area of concern for population health: Economic and Social (n=16), Physical Environment (n=10), Healthcare Services (n=12), Lifestyles (n=3), Mortality (n=15) and Morbidity (n=6) (Figure 1).

The set of indicators and main dimensions considered relevant to evaluate population health, reflected the diversity of points of view, making the consensus sometimes hard to achieve. Figure 2 presents the analysis of density functions, showing a slight dispersion in the classifications. The distribution of points of view could be considered clearly leptokurtic, with slight positive asymmetry. In the case of the Public Health and Physicians groups, the dispersion was greater, demonstrating more heterogeneity of points of view. As regards the Healthcare Management and Economics, Environment and Territory groups, the flattening reduced again (increase in concentration around mode).

In relation to Healthcare Management and Economics and Environment alone, there was a local maximum that was respectively positive and negative, reflecting the identification by the first group of a small cluster of indicators that were clearly uninteresting for population health evaluation, while the Environment group clearly highlighted a small group of indicators that were positive. The Territory group behaved similarly to the Healthcare Management and Economics group, although the group of indicators deemed unimportant was larger.

**Table 1.** Correlation matrix between expert groups.

| | **Public Health** | **Physicians** | **Healthcare Management and Economics** | **Environment** | **Territory** |
|---|---|---|---|---|---|
| **Public Health** | 1 | | | | |
| **Physicians** | 0,61 | 1 | | | |
| **Healthcare Management and Economics** | 0,63 | 0,51 | 1 | | |
| **Environment** | 0,04 | 0,06 | 0,24 | 1 | |
| **Territory** | 0,38 | 0,66 | 0,44 | 0,06 | 1 |

Source: Analysis of experts' answers of Delphi panel.

Table 1 shows the matrix of non-linear correlations between the expert groups' judgments. The responses of the Public Health, Physicians and Healthcare Management and Economics groups behaved similarly (r=0.61 and r=0.63, respectively), and there was also a similar classification between Territory and Physicians groups (r =0.66).

## 5. CONCLUSIONS

The selection of a set of indicators providing a holistic picture of the population health is challenging, but essential. A comprehensive measure needs to integrate multiple indicators relating to health determinants (e.g. economic and social, built and physical environment, lifestyles, health services) and indicators or proxies that are able to express health outcomes (mortality and morbidity). The main aim of PHI is to provide Portuguese decision-makers (particularly at local government level) with evidence of the main problems in each municipality, indicating the priority areas for intervention.

The involvement of experts, from different knowledge areas and from national institutions with responsibilities in major policy areas of concern for health, provided a holistic and prolific discussion around the multidimensionality of population health evaluation. The recognition of the importance of addressing areas outside the exclusive scope of healthcare, involving environmental, social and economic criteria, led to a total involvement of the 26 experts in the selection of the core dimensions and indicators to integrate the PHI measure.

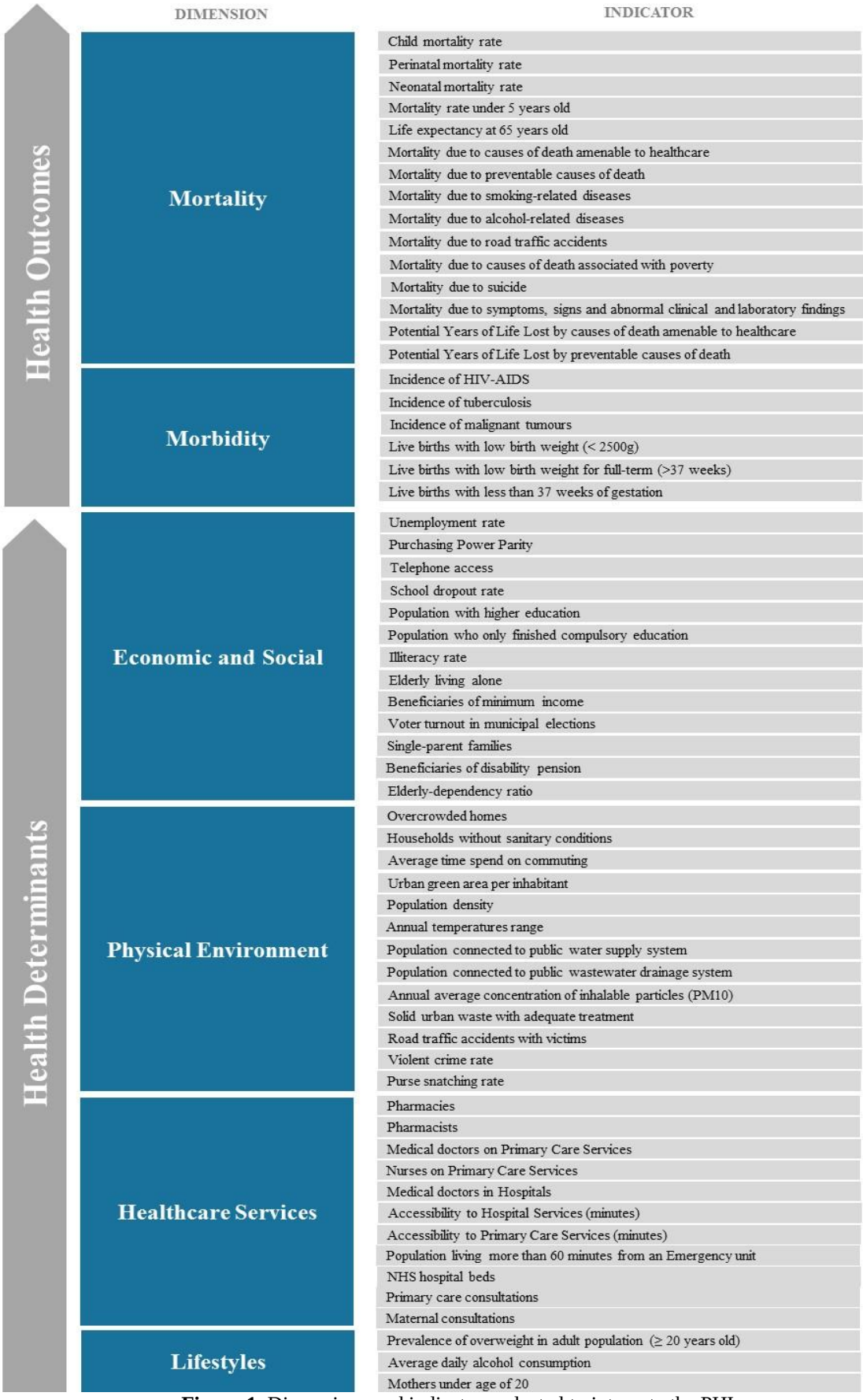


**Figure 1.** Dimensions and indicators selected to integrate the PHI.

When selecting indicators according to their usefulness for population health evaluation, experts were faced with constraints and limitations related to data quality, namely related with the reliability, validity, availability and comparability of data for the desired spatial and temporal scales: at municipality level and for the years 1991, 2001 and 2011. Hence, the selected indicators were subject to careful analysis and review, made by the nominal group, with regards to their relevance, credibility and analytic soundness and measurability. This review resulted on the validation of the 62 indicators, although some considerations were made regarding the constraints in having available data disaggregated at municipality level for the year 1991.

The selected indicators, grouped into dimensions, were considered as index components and thus the main structure of the PHI was set up: the Health Determinants area aggregates dimensions related with the economic, social and environmental conditions, healthcare services and lifestyles, and the Health Outcomes area integrates mortality and morbidity indicators. The structure of the PHI reflects the diversity of points of view in relation to the indicators to be considered in population health evaluation. The experts' responses were diverse, highlighting the complexity of the problem they were addressing. Yet, the application of a participatory approach, using a combination of Delphi method and nominal group technique, proved adequate to the complexity of population health evaluation, with satisfactory results relative to the level of consensus generated between experts from such diverse areas of knowledge.

The economic and social indicators along with physical and built environment achieved a high level of consensus between the experts confirming the importance given to determinants in the evaluation of population health (Dahlgren & Whitehead, 2007; Marmot et al., 2008).
The Economic and Social dimension includes not only health determinants related to economic indicators but also social equity factors, ranging from family and social structure (single parents, elderly people living alone, elderly dependency ratio) (Marmot, 2005; Scharte & Bolte, 2013), to potential socio-material deprivation status (beneficiaries of welfare assistance for poverty or disability) (Santana, 2002) and indicators of public involvement and social capital, such as voter turnout. Indicators related to levels of educational achievement are also included in this dimension since education is recognized as a basic indicator of the function of health production, particularly in terms of behaviour and lifestyle (Marcus, 2006). The most highly educated sectors of the population use the primary care and preventive/diagnosis services most often (Ferreira & Santana, 2006). In fact, the Healthcare Management and Economics, Physicians and Public Health groups presented high level of agreement with the inclusion of these indicators. The Environment group considered that even the Social Equity area was of major relevance for population health evaluation.

The Physical Environment dimension integrates indicators related to environmental quality, encompassing those with known associations and adverse health outcomes with regard to air quality (concentration of particulate matter - PM10), water (public water supply and wastewater drainage), environmental hazards (collection and final disposal of waste) and climate biocomfort (annual range of temperature) (Deguen et al., 2010; Medina-Ramón et al., 2006). This dimension also includes the built environment by considering housing and neighbourhood conditions. Structural features of communities such as physical design of streets and safety structures are associated to different risk levels. Aspects related to density (inhabitants/area), land use (urban green spaces), commuting and housing conditions (overcrowding and sanitation) are also considered (Hood, 2005). Feelings of insecurity in the community also have a negative impact on population health (including mental health), so safety indicators (such as violent crime rates and road accidents) were selected to reflect this concern. Deaths from road traffic accidents are considered to be avoidable. Communities that have a high concentration of road traffic accidents with victims report increased feelings of

insecurity, particularly among pedestrians, with children being the most frequent victims of hit-and-run accidents. It also constitutes a public health problem since it is related to public prevention and policy performance (Jackson & Stafford, 2009). Significant note must be given to the importance given by Environment group of experts to this area of concern.

Healthcare services are usually considered to be an important health determinant, although the degree to which medical care impacts health over and above social and economic conditions has been the subject of considerable controversy. This area of concern encompasses access to healthcare services, including primary and hospital care and preventive services, like pharmacies (Santana, 2005). This dimension also reflect aspects of geographic accessibility to healthcare services, provision of doctors and other health professionals, availability of hospital beds, and also the utilization rate of primary and maternal health care services. All experts, regardless knowledge area, considered the indicators of healthcare services relevant to the evaluation of population health in a given municipality.

Lifestyle constitutes one of main dimensions with good agreement between experts, namely by those in the Territory group. Characteristics of social, physical, and cultural context can affect population health by facilitating or inhibiting healthy behaviours. Some of the nation's leading health indicators were selected as evaluation criteria, cited as major determinants of morbidity and premature mortality: excess weight/obesity and alcohol consumption (Wilson et al., 2010). Another indicator related with individual behaviour is teenage pregnancy, an indicator normally associated with disadvantaged social contexts and families, low educational levels and income, and considered also as health illiteracy indicator. There is a well-known association with births to teenage mothers and low birth weight, resulting in future social and health risks for the child (Maynard, 1997).

The Mortality dimension concerns avoidable mortality, years of potential life lost or life expectancy. For instance, it is important to identify geographical areas (municipalities) with high mortality under 75 years old, especially when they occur from causes that should not occur in the presence of timely and effective interventions from the healthcare system or are preventable by behaviour (such as alcohol and tobacco consumption, traffic accidents) (Hoffmann et al., 2014). In fact, avoidable deaths amenable to healthcare and infant mortality were considered the most relevant health outcomes indicators that achieved a high degree of consensus by all groups of experts, followed by avoidable deaths amenable to preventable causes (indicated by Territory, Environment and Physicians experts).

The Morbidity dimension highlights child morbidity and specific diseases such as cancer, HIV-AIDS and tuberculosis. Incidence of these causes are related with exposure to conditions of infection and contextual determinants such as nonstandard (abnormal) and/or crowded accommodation, unemployment and immigrant populations (Couceiro et al., 2011). Furthermore, it includes indicators related with low birth weight, associated with the quality of pre-natal assistance, lifestyle and mother's health (Harding et al., 2006; Santana et al., 2015).

As PHI will give the opportunity to measure the population health of each municipality, not only in terms of overall value but also by dimension and within each dimension, it will be necessary to structure the set of selected indicators, specifying the core evaluation criteria and respective descriptors on which the health of the population should be appraised, building value functions and assessing coefficient weights. This next phase of the PHI building process will be developed resorting to a multicriteria methodology combined with participatory approach (Rodrigues, 2014).

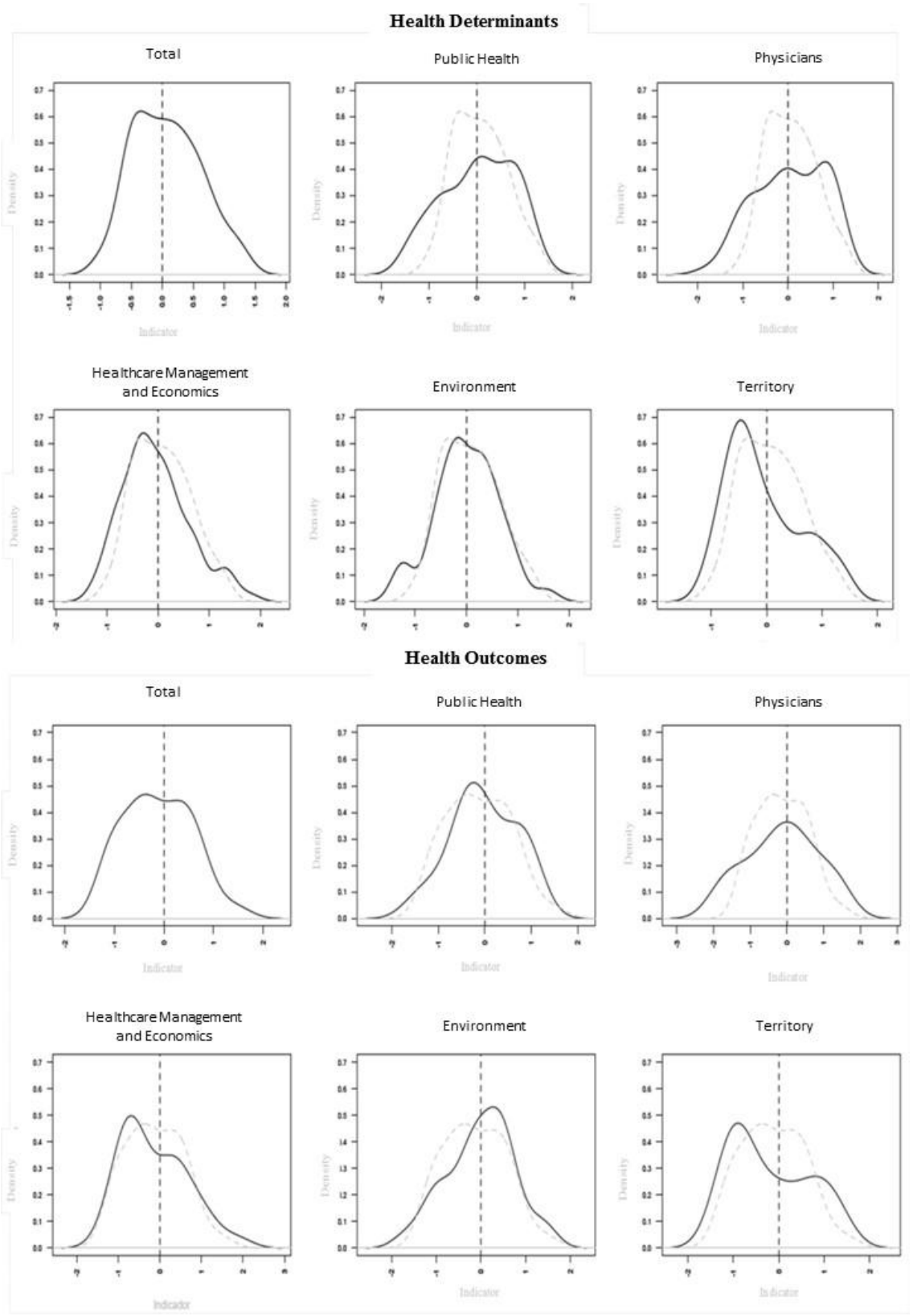


**Figure 2.** Density Functions by area and group of expertise.

In the present economic-financial crisis, in which public resources are becoming scarcer and more sought after, it is increasingly necessary to have this type of multidimensional and participatory measures supporting policy-making, supplying the necessary justificatory framework and giving indications about the best combination between the available resources and desired results. By its evidence, PHI can contribute to the implementation of a whole-of-government approach and partnership in each municipality, integrating planning, transport, housing, education, environment and health.

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(http://www.uc.pt/fluc/gigs/GeoHealthS)

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