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How can We conceptualize and measure Population Health Status ? : A Case Study of Portugal

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The Measurement and evaluation of health status is one of the most challenging issues of our time. This paper describes a one year research study about the construction of a health status evaluation model. The model was implemented in Portugal using information of the 90's. Health status varies considerably: lowest scores are observed in peripheral zones of the inland of the country, far away from the main structural axes located at the coast.

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The measurement and evaluation of health status is one of the most challenging issues of our time. Health status evaluation, besides its intellectual or scientific interests, is a central issue of health care quality control and effectiveness. Methodological difficulties, such as factors and their different weights, the relevance of individual characteristics – of patients or healthy people- and the definition of a "good" health status (and evaluation is, actually, the measurement of gaps between "good" and "real" health status) are some of the obstacles researchers must face. Nevertheless, almost all research about health status evaluation deals with the development of measurement instruments of individual or pathological situations. This is done trying to find out the 'utility' of health care to obtain healthier situations, i.e., measuring health care out-comes and effectiveness.

This paper describes a one-year research study of Portuguese consultants (physicians, geographers, health economists and health administrators) about the construction of a health status evaluation model which is able to evaluate the health status of a 'normal' population of Portuguese municipalities and regions; which is reliable, to be used as a method to improve the quality of local and regional planning of social and health equipment; which is adequate to support political and technical decisions on resource allocation and to evaluate their effectiveness; which is capable of measuring and comparing different population's health status and to monitor the evolution of a given population's health status along time; and which is economic i.e., that can use data and information already available. The aim of this paper is to stress geographical health status inequalities of the Portuguese population in

the 90th decade, conceiving a methodology to answer three main questions: i) which factors influence community health status; ii) how can they be measured, and iii) what is their relative weight on the health status. The use of such model is an important tool to identify inequalities on health and can provide an adequate support to the definition, implementation and monitoring of specific policies addressed to the reductions or elimination of such variations.

Population Health Status : A Conceptualization

A population will be healthier when the less disease situations occur on it. This simplistic approach reduces the community health situation to the sum of individual health status. It ignores a range of sanitary factors not directly related to biological health and presents a lot of operational difficulties of implementation. It involves the monitoring of individual health situations and the definition of each one of the many existing pathology weights.

Population health status is the result of a lot of factors or 'determinants' related to aspects of individual and community life (2). Kostrzewski (23) argues that: "measurement of level of health" is taken to include the incidence and prevalence of specific diseases and syndromes, and measurements of physical and mental conditions, as well as the attitudes towards health and health-related activities.

Using an approach based on 'needs' and 'satisfaction' concepts, we can say that a population have a 'good' health status when its citizens' health needs are completely satisfied by health services (15, 19). Besides the difficulties with the concepts of needs and satisfaction, it is not clear in what measure health status depends on the satisfaction of health needs, i.e., the balance between demand and health services provision (3). Even if we consider that ' good' health is just a question of the balance between needs and their satisfaction, it will be always difficult to define the real dimensions of such balance, considering type, quantity, quality, accessibility and price of health care (5).

The WHO comprehensive concept of health integrates three different levels of a population's health – biological, psychical and social - under a public health perspective. To define situations of complete individual welfare, which is necessarily different, in the same community, from one person to another (considering their culture, education, religion, economic status, age, gender, etc). and the utopian aim of such a concept is the main limitation of WHO health definition.

During a long period, from the 50's to the 90's, the human health was studied on an individual basis, despite the community studies concerning geographical variations on health. Macintyre (30) reported that: "since the early 1990's there has been a resurgence of interest in the role of place in shaping people's health experiences."

The place, considering its physical and social dimensions, can affect health and those health related behaviours (1, 6, 27, 29, 48). Diez-Roux *et.al.* (7) examined relations between place's characteristics and the incidence of coronary diseases, concluding that those living in more disadvantaged places present an higher risk of being ill than those living in better quality places, even after controlling for individual characteristics of income, education and occupation.

The interest to know the causes for unequal and poor health has initiated the revival of structuralist and environmental influences on health instead of considering, exclusively,

those health determinants related with individual characteristics, behaviours and diseases (30). These perspective lands to a 'new era' of health research, announced as the recovery of the relevance of the place to explain the causes of poor health and disease. The innovation of this approach is on the emphasis on social issues (social support and networks), industry social capital and social cohesion and their impact on health. In this context, Macintyre (30) argues "it might be helpful, firstly, to distinguish between compositional and contextual explanation for spatial variations in health; secondly, to include collective social functioning and social practices as candidate contextual mechanisms; thirdly to expand our conceptualization of collective social functioning beyond the confines of social capital/social cohesion, to include other features of non-material culture; fourthly to derive measures of context from an analysis of basic human needs; and finally, to develop robust, testable hypotheses about the potential impact of features of the local, social and physical environment on human health, and to test them empirically."

Population Health Status: Which Factors influence Community Health Status?

One of the most challenging subjects to health researchers has been the health variations measurement, how they occur in time and space, and why do they occur, together with the identification of risk groups and geographical areas (8, 17, 24, 25, 43, 44). The need to study health variations and, consequently, the causes of inequalities, is the result of the strategy adopted by several countries to fight against these variations, improving health of more disadvantaged people (32).

The first question to be answered is: What factors influence a community health status? A community, as a social organism, is not comparable with an human body, suffering of pathology or in a risk situation. Nevertheless, it is possible to establish some similarities between both. At a social level, pathological situations have symptoms that we can know and measure.

There are several ways of approaching health and health status inequalities, corresponding to a wide variety of factors that can be identified as determinants of health. However, we can conclude that there is always a strong and dynamic connection between socio-economic condition (context and composition) and health (7, 20, 21, 29) and that this connection goes through individual life since the gestation till death (37, 38). It is known that people from less favourable socioeconomic categories have a heavier burden of illness and present higher mortality rates than those from more favourable status. They also show higher health risks and have lower access to care, both in terms of quality and quantity (39, 41). Lower social classes work in less healthy physical environments. Material and social resources, including educational level also present variations on the social scale with impact on health status (20). Lahelma *et. al.* (26) propose other factors to be considered when analysing health status variation as age, region, socio-economic status, employment, and family and friendship relationships. Social and economic circumstances of people's life thus appear to have a role on population's health. Health issues have been looked into from the perspectives of gender also. During several years western societies believed that ill health was a phenomena explained by gender – women living more than men. However, recent research shows that gender differences vary according to used indicators and age (26). Finnish researchers had concluded that

women presented worse health status than men when evaluating somatic symptoms, mental symptoms, incapability and long-term illness with or without incapability. On the other hand, men presented worse health status as well as long-term incapability situations from the age of 50 years onwards. So, age is a health determinant to be considered. Individual self-perceived health status or physical incapability suffers changes with age. Nevertheless we cannot just conclude that health status always grow worse with age.

During the second half of the 20th century authors confirmed the essential role of health services on population health status and that they must answer in an equitable way to real needs of population (41, 46). In consequence, health services experienced a large scale changes on their organisation, distribution and types of healthcare provision. The availability of health care and, especially, their accessibility define the population's capacity to face disease. The accessibility of different kinds of health services may be used as a correction factor to the simple availability of health services. Whiteleg (47), Joseph & Bantok (18), Illsey and Le Grand (14), Santana (39), Haynes and Gale (12), and Santana (40) are some of the authors who related health services to the individual and collective health and morbidity patterns.

There have been changes in demands and needs for healthcare services, and also in the provision health care services. Disease patterns too have been changing. Main problems are essentially related with the maintenance of health services, accessibility gaps and inequities, the growing of health expenses, the apparent failure of more traditional solutions and, finally, with the anxiety of societies and health service users regarding the effectiveness of healthcare outcomes, i.e., the real impact of healthcare on individual and collective health status. Many authors refer to the relation between health and health care services utilization (33, 34). The "Health Communities 2000 – Model Standards – Guidelines for Community Attainment of the Year 2000 National Health Objectives" and "Health People" (11), both from the American Department of Health and Human Services, are important contributions to the definition of health services utilization factors.

Population Health Status in Portugal

Materials and Methods

The two most important data sources of the evaluation of population health status model was the Statistical National System (health, demographic and socio-economic indicators) and the Health Ministry (provision of health resources and health services utilization) concerning 1996. The study considers the total population of Continental Portugal distributed by 276 municipalities.

Adopted methodology (45) places three different questions: 1. which factors influence community health status (and can be used to measure population health)? 2. how can they be measured (and if they have different measuring systems, how can we put them all together)? 3. what is their relative weight on the health status? The answer to the second question depends on the nature of factors and of their measuring units. But the first and the third questions present a lot of research and methodological problems. There is little research and literature about this subject. We must also consider the adequacy of a model that can integrate, in a logical, simple and harmonious way, all the data we need to use.

1.Which factors influence community health status (and can be used to measure population health)?

The list of factors that comprise the evaluation model was submitted to a panel of Portuguese experts (physicians, health economists, administrators, geographers, etc.) who suggested several changes. At last, consensus was reached, with the factors divided into six 'families' or factor related groups: i) Health Indicators; ii) Demographic Indicators; iii) Health Care Provision; iv) Health Services Utilisation; v) Social Indicators; and vi) Economic Indicators.

Health Indicators

This group includes factors that reflect not only the health services out-comes but also the impact of life style and social and development policies. It is rather difficult to establish the contribution of health services activity in those indicators (such as mortality rates) or whether variations are more related with some basic life conditions such as sanitation or drinkable water supply. This group comprises nine indicators – prenatal mortality rate, neonatal mortality rate, infant mortality rate, 1-4 years old specific mortality rate, mortality pattern (per cent of five mortality causes associated with low levels of social development – undefined symptoms and affections, pneumonia and influenza, chronic bronchitis and asthma, chronic liver disease and liver cirrhosis, transmissible diseases – in the mortality), deliveries without assistance, tuberculosis incidence (at municipality level, number of new cases, at municipality groups and districts level, new cases per 1000 inhabitants notifiable diseases incidence (at municipalities level, number of new cases; at municipality groups and districts, new cases per 1000 inhabitants) and vaccine inoculation rate (children under 2 years old – measles, poliomyelitis, dtp and rubella). Some important indicators were not considered by the model (maternal mortality, morbidity rates and physical activity and sport, tobacco and alcohol consumption, sexual and dietary habits, food and drugs security, and some clinical indicators such as blood pressure) because of the lack of reliable information.

Demographic indicators

This group integrates five factors – general mortality rate, fertility rate, per cent of resident population over 65 years old, per cent of resident population under 15 years old and women/men ratio. Some factors (life expectancy at birth, birth-rate, etc) were ignored for the same reasons as the first group.

Health Care Provision

This group integrates information about availability, quantity and accessibility of health care provider services. The availability of health care and, especially, their geographical accessibility determines the population's capacity to face disease. The geographical accessibility of different types of health services can be used as a correction factor to the simple availability of health services. We don't consider health care quality because of the lack of systematic measure instruments. Health care price is also ignored not only because Portuguese NHS is free and patient's co-payments are equal all over the country but also because there are no control mechanisms over private sector prices. In spite of its local relevance, 'alternative' and traditional medicine was not considered because there is no available information about this activity. We have ignored hospitals waiting lists, average length-of-stay, occupancy rate and other activity indicators because of the difficulties of comparing and interpreting such indicators, and because there is no uniform data collection system.

Health Care Utilisation

This is another group of indicators of health services out-puts. In theory, better the health status is, the less people use medical services. Nevertheless, in Portugal some utilization rates are clearly low when compared with other countries. This is the case, for example, of health contacts (general practitioner and hospital consultations), hospital frequency etc. This situation legitimates the consideration, at least for now (few resources and economic, geographical and cultural difficulties), that improving such utilization rates will correspond to improve health status. This group integrates 15 factors or indicators – general practitioners consultations/ inhabitants, maternal care (average number of pregnant women visits), infant care (percentage of children born in the year and went to a first visit in health centre), school health care (percentage of basic and primary schools with health activities), family planning (first health centre visits of family planning of women with 15-49 years old), 'sap' visits/inhabitants ('emergency room' of health centers), rural hospitals discharge rates, rural hospital length of stay, hospital out-patient visits/inhabitants, hospital emergencies/ inhabitants, hospital discharges/ inhabitants, hospital length of stay, drugs consumption/ inhabitants, labs radiology & treatments / inhabitants, and health public expenditure/ inhabitants.

Social Indicators

A fifth group comprises social indicators, reflecting the relevance of such indicators to population health status. It integrates five factors – illiterate adult's percentage, per cent of resident population with more than 4 school years, home water supply rate, home electricity supply rate, and residential phones/inhabitants.

Economic Indicators

The income measured by the type of profession (blue and white collar worker), as a proxy is an important factor to restrain the access to a range of goods and services that may change the health status. This group integrates four factors – industrial employment (percentage of active population working in industry), agricultural employment (percentage of active population working in agriculture), unemployment rate and per capita income (regional index that integrates 12 others factors – taxation, income, consumption, etc.).

The complete model integrates 51 factors distributed by six "families" or factor groups (Table 1). We must remove or ignore some situations that demand a specific evaluation such as catastrophes, natural and ecological disasters, epidemics, etc. Such situations should not be considered by the model, but it should be sensible to their impact on population health. We are unable to include data that would require new surveys to be carried out or which has been collected all irregular time intervals. We expect that such exclusion criteria would be used only in a few and exceptional cases. But, for example, all the available data about life styles (drugs and alcohol consumption, smoke, sexual and dietary), 'family's' health expenditures, etc, collected by the National Health Survey, only refer to regional level.

2. *How can they be measured (and if they have different measuring systems, how can we put them all together)?*

3. *What is their relative weight on the health status?*

Many factors have different measuring systems or units – quantitative and qualitative measures. So, this model must convert all

measures to one single evaluation measure scale. Expert panels also attribute weights to each factor, reflecting its relevance to explain population health status (relative importance of the factor). So, while utility score depends on the actual value of a factor, its weight is constant (unless there is a strong reason to change it).

Table 1

Weights to Factor Groups or "Families"

Factor Groups	*Weights*
Health Indicators	2.65
Health Services Utilisation	2.20
Health Services Provision	2.05
Demographic Indicators	1.40
Social Indicators	0.90
Economic Indicators	0.80

The weights were estimated through consecutive operations of weighing of each factor group and individual factors. It's also essential that such evaluation measurements scale unit can assess the contribution of each actual value of each factor. The model integrates 51 conversion tables that estimates the utility score. Here, utility score means an evaluation measure of the actual values of one factor to explain health status. For example, a lower infant mortality rate has a higher utility to explain a "good" health status than a higher rate of each possible value of each factor. The best value of each factor corresponds to a utility score of 100 and the worst to a 10 utility score. The best value of a factor was defined by experts, considering national and international, desirable or possible values of that indicator. The same was determined for the worst value also. Some of the conversion tables have only 3 or 5 positions, while others have 80, considering the utility curves designed by experts and the nature of each factor.

The adopted model, a multi-attribute utility model (multi-criteria), is a very simple mathematical model (45). It compares the relative utility of different options or situations, in this case, different health status of different populations. The model can be used either to measure the same population health status through time or to compare health status of different populations.

Nevertheless, we must have information about all factors or we have to rebuild the model, and estimate new weights for each factor.

Utility estimate of a factor : $U(j) = S(ij) \times W(j)$

Total health status score : $THS = U(1) - U(n)$

Where :

$U(j)$ = Utility Score of factor j

$S(ij)$ = Utility score of actual value of factor j

$W(j)$ = Weight of factor j

THS = Total Health Status of a given municipality

This model is supported by a simple software that automatically converts actual values in utilities and estimates factors, and group of factors and total utility scores for each considered territorial unit. So, we can get a score for each municipality, group of municipalities and district by factor, group of factors and total utility score. The model can also be used as a simulation tool, manipulating factor values. The health status of Portguese population of 1996 by municipality was evaluated using the above-described model.

Fig.1 shows six health status scores clusters (sextiles). Using the method described by Holland *et. al.* (38), the clusters of the top and

of the bottom, integrating respectively the highest and the lowest health status scores, correspond each to 10% of the evaluated municipalities. The interval between these extreme classes was then divided into four equal clusters (each one of them representing 20% of evaluated municipalities). The total possible score (if all the factors presented actual values corresponding to the maximum utility) of the model is 1,000. From the 276 evaluated municipalities, 129 (46.7%) presented health status scores lower than the average – 484.4. Ninety six are rural municipalities; 25 are urban municipalities of the inland; and only 8 belongs to the littoral areas.

Model outcomes show that those municipalities located at the coastal area have health status scores higher (sometime more than the double) than those of the country inland. The highest scores don't correspond to those municipalities where the two more important Portuguese cities (Lisbon and Porto) are located, but the best ranking corresponds to those municipalities surrounding Lisbon and Porto, i.e., cities of medium size. The highest score correspond to the municipality of Coimbra, in the central region (720). However, the lowest scoe is also from a municipality of the same region. Otherwise, almost all of the lower scores belong to interior municipalities.

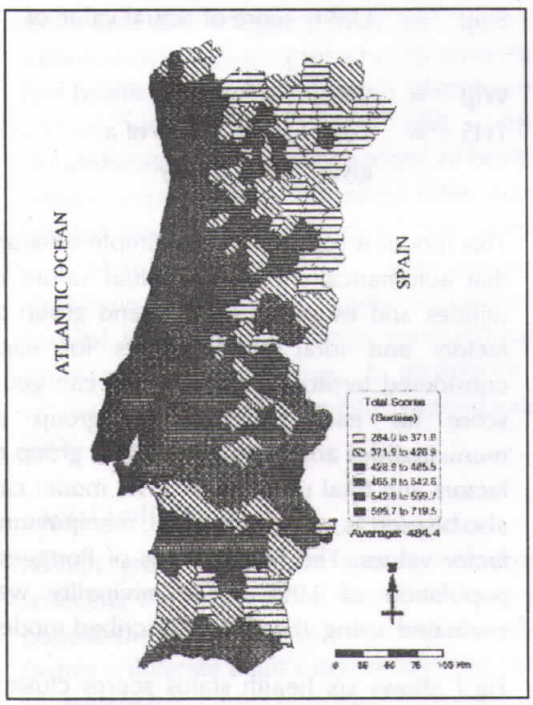

Fig. 1
Portuguese Population Health Status by Municipality - 1996

Discussion

The evaluation of Portuguese population health status clearly demonstrates the decrease of scores with the increase of rurality, ageing, illiteracy, distance to health services (mainly hospitals) and with the reduction of income, purchase power, electricity and sanitation coverage. Worse scores were registered in those municipalities located at the country's Northern inland, characterized by the loss of social and economic dynamics. Paradoxically, highest scores were not found in the municipalities with higher population size but in medium size urban municipalities (about 100,000 inhabitants), located in the surroundings of main road axis and enjoying the benefits of the goods and services offered by nearby metropolis. There is an evident dichotomy between the urban littoral and the rural inland. In Italy, Costa and Faggiano (39) also found a strong relationship between high mortality and residence areas for both gender, especially considering mortality rate differences of young adults, according to the educational level, between the North and the South of Italy.

One of the explanations for this health status distribution, justifying the scores of inland municipalities, is because of their high rates of ageing and ferminisation and, as is already well known, ageing has a strong and natural

influence over health status and health care consumption (26, 28, 40). Women, and elderly and younger people use more health care resources. In fact, it is not possible to establish a clear relation between use of health care and health status, but the universality of such patterns supports such consideration, that means, there is a relation between ageing, sex and other demographic characteristics and the consumption of health care and population health status. The study shows that higher population needs (depending on gender, age and morbidity) do not correspond, in general, to better access to health services (geographical and organizational) or higher rates of health services utilization (mainly hospitals). However it is difficult to clearly identify the contribution of health services activity in those indicators (such as mortality rates) that have, for sure, an important contribution.

The same kind of variations was found regarding social and economic indicators. Northern inland municipalities present higher rates of illiteracy, a very expressive percentage of the population working on agriculture, with the main sources of individual and familiar income being retirement pensions and the Minimum Social Income.

Besides the evaluation of the impact of individual variables, such as income or education, it is important to consider places' characteristics and observe how they play a relevant role (7, 29). Social-economic attributes should be understood in a geographical basis, corresponding to the residence area (environmental factors, community's characteristics, quality and quantity of health services, etc.). The influence of the place on health status can be positive or negative, changing the individual relationship – social class / health status. Gatrell (9) refers, concretely, to the relation between the role of the residence geographical location (urban and rural areas, poor and wealthy areas) and health outcomes. So, factors that determine health inequities are, in one side, economic conditions of individuals and families (occupation, income, etc.) and, in the other side, those conditioning of regions and countries (social, health and education policies), all together with places, conditions (goods and services offer, etc.). Jones e Duncan (16) argues:

"Not only do places differ, but place makes a difference. From this perspective, health outcomes depend not only on individual characteristics (age, gender, class), but also on the setting, the 'ecology', and the surrounding environment in which live and work".

Our results also suggest that "place makes a difference" in the Portuguese's health status: poor people and those needing healthcare seem to live in more distant areas from the concentration of goods and services. There are also some conditions of the physical environment such as sanitation or drinkable water supply with geographical inequal distribution in Portugal at the beginning of the 90's, presenting a poor situation in rural and interior areas. Some authors, as Cayolla da Mota (3, 4), Giraldes (10), Pereira et.al (34), Pereira (35), Pereira (36), Santana (39, 40) and Nogueira e Santana (31), have found strong correlations between some of described indicators and SMR, population's health status and development levels in Portugal.

To mitigate the impact of poverty conditions on health, multi sectoral policies should be implemented to improve collective living conditions on rural peripheral and poor places. Or, as Kennedy *et al.* (22) refer, a more equitable national distribution of income will be the right answer to this problem.

The geographical health status inequities found by the application of this model are the consequence not only of individual and collective factors, but also of the adopted development model, which emphasizes the concentration of main economic activities at littoral areas, creating powerful poles that attracts the youngest population from the inland. The Portuguese development model had also determined the adoption of a health paradigm, based upon a dominant curative approach. The depreciation of primary heatlh care – the most cost effective health services – has had, as a consequence, the weakness of almost all preventive activities and a reduced activity concerning changes in life styles and behaviours. Only the adoption of more adequate and fair redistributive policies, together with a new emphasis on primary health care, considering the specificities of different places and their population, will be an adequate solution to reduce the identified health inequities.

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