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Which socio-economic groups benefit most from public health expenditure in Senegal? A dynamic benefit incidence analysis

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ABSTRACT

Despite efforts to enhance public investment in Senegal's health sector, the equitable distribution of benefits between socioeconomic groups remains largely unexplored. To address this gap, our study examines the progressive (or regressive) nature of public health expenditure. Utilizing data from the latest survey on household living conditions (2018–2019) in conjunction with administrative data on health expenditure from the same period (provided by the Ministry of Health of Senegal), we performed a benefit incidence analysis. This entailed segmenting the population by poverty quintiles and subsequently estimating how each group utilized and benefitted from public health expenditure, according to level of care and geographical location. Additionally, we performed a marginal benefit analysis to discern the impact of an increase in public health expenditure on various socioeconomic groups. Our findings unveil a pro-rich distribution of benefits at both primary healthcare and hospital levels, observable both at national and regional levels. Moreover, disparities in the distribution of resource allocation between Senegal's 14 administrative regions were observed. Ultimately, our results indicate that under prevailing conditions, increasing public health expenditure would not yield a pro-poor distribution of benefits. Therefore, our research underscores the imperative of better targeting populations for greater equity between regions and social groups.

1. Introduction

The Sustainable Development Goals (SDGs) have confirmed Universal Health Coverage (UHC) as a priority on the global health agenda. UHC aims to ensure equitable access to high-quality health services for all, without the risk of financial hardship or impoverishment (World Health Organization, 2010). A fundamental tenet of UHC is that access to healthcare should be based on need rather than on financial capacity (Kutzin, 2013; Potvin et al., 2007; Wagstaff et al., 1991). Consequently, health policies should be evaluated based on their capacity to reduce health disparities between populations, which is central to the UHC objective (Ridde et al., 2022). In response to this imperative, low- and middle-income countries (LMICs), particularly those in sub-Saharan Africa, have recently embarked on health financing reforms. These reforms seek to expand financial protection against the economic risks associated with illness, aiming to reduce reliance on out-of-pocket payments (OOP) that often push households into poverty (Barasa et al., 2021).

However, the persistence of OOPs in sub-Saharan Africa poses challenges to achieving UHC, and the poorest segments of the population often bear the brunt of catastrophic health expenditure. It appears that African health systems are trapped in a cycle of inadequate public funding and a heavy reliance on household contributions to healthcare financing. This is exacerbated by enduring poverty and the informal nature of the labor market, which limit the ability of most vulnerable populations to afford health insurance (Barasa et al., 2021).

Henceforth, the two primary potential sources of health financing are foreign aid and domestic public resources (Kutzin, 2013). However, domestic resources have a more significant impact on health outcomes than external funding (Atim et al., 2020). Hence, prioritizing the mobilization of domestic resources is preferable, particularly considering the unsustainability of foreign debt in sub-Saharan countries. Moreover, the context of the COVID-19 crisis has heightened the reliance of LMICs on external aid and exposed their health systems to

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exogenous shocks. Therefore, under resource constraints and for the sake of allocative efficiency, evaluating the overall distribution of public health expenditure between different socio-economic strata emerges as a critical imperative. LMICs particularly face this challenge of ensuring equitable access and utilization of health services between social groups (Ridde et al., 2022).

Senegal pursues the UHC objective through two main policies: strengthening and broadening healthcare services, and extending health risk protection. The latter is operationalized through the "*Couverture Maladie Universelle*" program initiated in September 2013. Aligned with the related national health financing strategy, the government has intensified efforts to mobilize domestic resources for health. The overarching goal is to shield Senegalese households from the impoverishing effects of OOPs, while enhancing the medical infrastructure and services.

These government initiatives have significantly reduced the incidence of catastrophic health expenditure. A study on the impact of catastrophic health expenditure on impoverishment and utilization of healthcare services in Senegal (Ministère de la Santé et de l'Action Sociale, 2021a) indicated that the number of households encountering catastrophic health expenditure halved between 2011 and 2019, and their incidence declined by a 2.35-fold factor. This marks substantial progress in shielding populations from the risk of falling into poverty due to OOPs. However, in absolute terms, 18,941 households still faced catastrophic health expenditure in 2019, with disparities observed across various socioeconomic characteristic. For instance, households in the poorest quintile were 4.4 times more susceptible to catastrophic health expenditure than those in the wealthiest quintile. Similarly, rural households were 3.3 times more prone to catastrophic expenditure than their urban counterparts (Ministère de la Santé et de l'Action Sociale, 2021a).

Despite the government's commitment to increasing investment in health and the need of monitoring progress, to our knowledge, the distribution of the benefits of public health expenditure between different socioeconomic categories has not been measured yet in Senegal. While the national health accounts serve as a valuable tool for delineating the level, sources, and allocation of financial resources within the health system, they do not provide insights into the actual beneficiaries of these expenditures. Given the possible inequality and social distortions that may arise from the distribution of public health expenditure, the governments should measure the extent to which the poor have benefited from public expenditure (Demery, 2000). At this respect, this paper aims to analyze the distributive impact of public health expenditure in Senegal. Its general objective is to determine the distribution of the benefits resulting from increased public health expenditure on healthcare utilization. Specifically, it aims to evaluate, first, the average benefit and the progressivity of public health expenditure across different levels of care (hospital and primary healthcare (PHC) levels), between administrative regions, and according to the area of residence. Second, it aims to assess the marginal benefit of public health expenditure in Senegal.

2. Methods and data

2.1. Statistical approaches and models

2.1.1. Statistical approaches

- **Benefit incidence analysis**

Benefit Incidence Analysis (BIA) has become an established approach to analyze the distributive impact of health expenditure in LMICs. BIA seeks to attribute a monetary value on the utilization of health services as a way of assessing how the benefits from public health expenditure are distributed across a population ranked by socioeconomic status. Standard BIA combines the unit costs of health services with their utilization rate. That is, BIA assesses the way in which different groups benefit from public subsidies (Ajwad et al., 2011; Araar & Duclos, 2022; Fares & Puig-Junoy, 2021; Ogujiuba, 2022; Ridde et al., 2022). Relying on the reported use of government-funded services by households, BIA involves a three-step methodology (Demery, 2000).

- Estimation of Unit Subsidy: first, estimates are derived from the unit subsidy allocated to the provision of specific services. Typically, this estimation relies on officially reported public expenditure dedicated to the respective services.
- Imputation of Subsidy to Users: second, the determined unit subsidy is attributed ('imputed') to households or individuals identified as users of the subsidized service. Individuals accessing subsidized public services basically receive an in-kind transfer. BIA assesses the distribution of this transfer across the population.
- Aggregation into Sub-Groups: third, individuals (or households) are aggregated into sub-groups based on socioeconomic factors, so as to compare the distribution of the subsidy across these groups. The most common grouping criteria includes income or related measures of individual welfare, such as expenditure. In our case, aggregation is done at the quintile level.

The fundamental assumption underlying this kind of analysis is that public funds and the services they finance should exhibit a pro-poor bias, meaning they should disproportionately benefit the most disadvantaged socioeconomic groups (Demery, 2000). This presupposes that public expenditure should promote efficiency by correcting market failures and promote equity by improving the distribution of economic well-being (McIntyre & Ataguba, 2011). The method enables the expression of benefits derived from healthcare service utilization by different socioeconomic groups in monetary terms, contingent upon both service utilization rates and costs (Araar and Duclos, 2022). BIA has some limits, yet, among which its focus on average impact measures, thus preventing to provide insights as for the distribution of benefits resulting from additional monetary investments (Ajwad and Wodon, 2011; Ogujiuba, 2022).

- **Marginal Benefit Incidence**

Marginal Benefit Incidence (MBI) analysis addresses that limitation. By increasing healthcare expenditure, the government probably aims to boost healthcare service utilization. However, evaluating whether the government optimizes average utilization rates across regions and over time necessitates analysis of longitudinal healthcare utilization and expenditure data. Unfortunately, such panel data is often unavailable, posing challenges due to data heterogeneity. Thus, Ajwad and Wodon (2011) proposed a novel methodology, MBI analysis, using a single cross-sectional data. They recommend defining household quintiles based on departmental income distributions rather than on country-wide income distributions, so as to better reflect relative welfare within geographic areas. This method, which is aligned with relative deprivation theory, considers households' welfare relative to others in their locality. It proves particularly valuable in assessing how public expenditure benefits households across various regions, ensuring equitable distribution despite regional income disparities.

- **Progressivity of benefits**

Progressivity of benefits can be analyzed through index (IC) and concentration curves (CC). The method allows visualizing, in a graph, to what extent the distribution of benefits is unequal in favor of an income group. If the curve is above the 45° diagonal (line of equality), the expenditure distribution is pro-rich, and below the diagonal, it is pro-poor (McIntyre & Ataguba, 2011).

2.1.2. Model specifications

- **Benefit Incidence Analysis**

Consider a database with N observations (in our case, 7156 households), G socioeconomic groups, S sectors, R regions. Following Araar and Duclos (2022), let:

w_i be the sampling weight of household i;

y_i be the living standard of members belonging to household i (i.e., total annual household consumption expenditure);

e_i^s be the number of "eligible" members of household i, i.e., members that "need" the public service provided by sector s;

u_i^s be the number of members of household i that effectively use the public service provided by sector s;

g_i be the socio-economic group of eligible members of household i (typically classified by income percentiles);

c_i be a subgroup indicator for household i (e.g., 1 for a rural resident, and 2 for an urban resident) (eligible members can thus be grouped into population exclusive subgroups);

E_r^s be a subgroup indicator for household i (e.g., 1 for Region 1, 2 for Region 2, etc.) (eligible members can thus be grouped into population exclusive subgroups);

E^s be total public expenditure on sector s ($\sum^s = \sum_{r=1}^R E_r^s$)

Here are some of the statistics that can be computed.

The share of a socioeconomic group g in sector s is defined as follows:

$$SH_g^s = \frac{\sum_{j=1}^{n} w_i\, u_j^s I(i \epsilon g)}{\sum_{i=1}^{n} w_i\, u_i^s} \tag{1}$$

Note that: $\sum_{g=1}^{G} SH_g^s = 1$.

The utilization rate of a socioeconomic group g in sector s is defined as follows:

$$CR_g^s = \frac{\sum_{j=1}^{n} w_i\, u_j^s I(i \epsilon g)}{\sum_{j=1}^{n} w_i\, e_j^s I(i \epsilon g)} \tag{2}$$

This rate cannot exceed 100% since $u_i^s \leq e_i^s \forall i$

The unit cost of a given service in sector s for household j, which refers to the household members that live in area r:

$$UC_j^s = \frac{E_r^s}{\sum_{j=1}^{n_r} w_i u_i^s} \tag{3}$$

where n_r is the number of sampled households in area r.

The benefit of household i from the use of sector s is:

$$B_i^s = u_i^s * UC_i^s \tag{4}$$

The benefit of household i from the use of the S sectors is:

$$B_i = \sum_{s=1}^{S} B_i^s \tag{5}$$

The average benefit for those that use the service s and belong to a group g is defined as:

$$ABE_g^s = \frac{\sum_{i=1}^{n} w_i B_i^s I(i \epsilon g)}{\sum_{j=1}^{n_q} w_i u_j^s I(i \epsilon g)} \tag{6}$$

The proportion of benefits from the services from sector s that accrues to households belonging to group g is defined as:

$$PB_g^s = \frac{B_g^s}{E^s} \tag{7}$$

where $B_g^s = \sum_{i=1}^{n} w_i B_i^s I(i \epsilon g)$

These statistics can be restricted to specific socio-demographic groups (e.g., rural/urban) by replacing $I(i \epsilon g)$ by $I(i \epsilon c)$.

- **Progressivity of benefits: concentration index and curves**

In our study, we have $\{X_i, D_i\}$ with $i = 1 \ldots n$ set in ascending order where the income indicator is X_i (approximated by household consumption expenditure) and D_i represents public health expenditure. The concentration curve is defined by the following equation:

$$C_D\left(q = \frac{i}{n}\right) = \frac{1}{n\theta_D} \sum_{j=1}^{i} D_j \tag{8}$$

where θ_D stands for the average expenditure in the population. The parameter q refers to the population groups sorted out, in our case, into quintiles of total household consumption expenditure (food and non-food). If the whole population receives the same proportion of health expenditure θ_D, the concentration curve is identical to the first diagonal (line of equality). A positive value of this index means a pro-rich distribution, while a negative index means a pro-poor distribution.

- **Marginal benefit incidence analysis**

Following Ajwad and Wodon (2011), we consider the 14 regions of Senegal ($i = 1 \ldots 14$) and a certain number of households in each region. Households are classified according to their annual consumption expenditure, used in our study as a proxy for income, and assigned to one of $q = 1, \ldots, Q$ income intervals (e.g., quintile). Ranking is done locally, which means that intervals are defined within regions. Let X_{ij}^q stand for the benefit incidence of a program or service for household j belonging to interval q and living in region i. This benefit incidence reflects the share of the population that has access to healthcare. The average benefit incidence in interval q for households in department i is denoted by X_j^q, and the overall average for the region is denoted by $\overline{X}_i$. If J_i^q is the number of households in interval q for region i, both averages are respectively equal to the following:

$$X_i^q = \frac{\sum_{j=1}^{J_i^q} x_{ij}^q}{J_i^q} \tag{9}$$

and

$$\overline{X}_i = \frac{\sum_{q=1}^{Q} \sum_{j=1}^{J_i^q} x_{ij}^q}{\sum_{q=1}^{Q} J_i^q} \tag{10}$$

To estimate the marginal benefit incidence, i.e., who benefits from an increase in public health expenditure, we use geographic variation in access both between households and between regions as a source of information variation. To do this, we regress the incidence in each of the intervals in the regions against the regional means, using quantile regressions (Ajwad and Wodon, 2011).

$$X_i^q = \alpha^q + \beta^q \left(\frac{\sum_{q=1, j=1}^{Q, J_i^q} x_{ij}^q - \sum_{j=1}^{J_i^q} x_{ij}^q}{\sum_{q=1}^{Q} J_i^q - J_i^q} \right) + \epsilon_i^q \tag{11}$$

As shown by Ajwad and Wodon (2011), equation (11) allows analyzing the incidence of benefits in the interval q with respect to the change in the average incidence of regional benefits. However, the average incidence of regional benefits depends on the incidence in the

interval q. This endogeneity is avoided by using, as an instrument in the estimation in (11), the regional average for all regions except for those belonging to interval q. We obtain:

$$X_i^q = \sum_{q=1}^{Q} \alpha^q + \sum_{q=1}^{Q} \beta^q \left(\frac{\sum_{q=1,j=1}^{Q,J_i^q} x_{ij}^q - \sum_{j=1}^{J_i^q} x_{ij}^q}{\sum_{q=1}^{Q} J_i^q - J_i^q} \right) + \epsilon_i^q \tag{12}$$

In equation (12), the intercept and slopes may differ for the different intervals, subject to an implicit restriction. This restriction is that the average of the marginal benefit incidence for the different groups must equal unity. By proceeding to the total differentiation of this average, we obtain:

$$\sum_{q=1}^{Q} \frac{\beta^q}{Q-1+\beta^q} = 1 \tag{13}$$

Writing β^Q, the parameter of the interval Q with respect to the other parameters gives the following result:

$$\beta^q = \frac{(Q-1)\left(1 - \sum_{q=1}^{Q-1} \frac{\beta^q}{Q-1+\beta^q}\right)}{\sum_{q=1}^{Q-1} \frac{\beta^q}{Q-1+\beta^q}} \tag{14}$$

Taking restriction (14) into account, equation (12) is estimated with nonlinear least squares. It is also possible to show that a change in the incidence of the benefit for households belonging to quintile q in response to an increase in the total benefit incidence is as follows:

$$\frac{\partial X_i^q}{\partial \bar{X}_i} = \frac{Q\beta^q}{Q-1+\beta^q} \quad q = 1 \ldots\ldots Q \tag{15}$$

The values presented on the right side of equation (15) represent the estimates of the incidence of marginal benefits. A value above (resp. below) unity signifies that the respective group of households benefits more (resp. less) than the average from an increase in public health expenditure. We proceed to estimate the marginal incidence of benefits ensuing from increased health expenditure at both PHC and hospital levels.

We conducted the BIA and MBI analyses, and calculated concentration index and concentration curves using Distributive Analysis Stata Package (DASP) version 3.03 as indicated in Araar and Duclos (2022). We used the *bian.ado* module to compute these different statistics.

2.2. Study area

Senegal is a Sahelian country located in the extreme West of the African continent. The country covers an area of 196,712 km^2 and has 14 administrative regions, including that of Dakar, the capital city. The healthcare supply is characterized by significant disparities between regions, with a higher concentration in the regions of Dakar and Thiès (Paul et al., 2020). These geographical disparities are coupled with inequalities in terms of professional category (Agence Nationale de la statistique et de la démographie, 2020; Ministère de la santé et de l'action sociale, 2021b).

Senegal has a young population, and the potential of demographic dividend constitutes a challenge for public authorities in terms of jobs, training, and health (Centre Régional de Recherche en Economie Générationnelle, 2021). Furthermore, even if declining, mortality rates remain high and vary between socioeconomic strata (Agence Nationale de la statistique et de la démographie, 2019). The health system is organized along a pyramidal structure with three levels: primary (huts, posts and health centers, primary public hospitals), intermediate (secondary public hospitals) and central level (tertiary public hospitals) (Ministère de la Santé et de l'Action sociale, 2019). To be consistent with the structure of available data, we simplify the classification and distinguish between hospitals (reference level) and PHC facilities (composed of health centers and health posts).

2.3. Data sources

To conduct BIA and MBI analyses, two secondary sources of information were used. The first is the latest "Harmonized Household Living Conditions Survey" (EHCVM 2018–2019), funded by the World Bank, from which we extracted data on services utilization and on socioeconomic groups. This includes both the household and community components. In this study, we focused on the household questionnaires, which were administered to the head of the household, who had to list all the individuals in the household and responds on their behalf.

The survey's sample is representative at regional and national levels and comprises 7156 surveyed households. Households were grouped into income quintiles, approximated by total annual household consumption (National Agency for Statistics and Demography, 2021). More details are available in the EHCVM final report.

The second data source stems from the Directorate of the General Administration and Equipment of the Ministry of Health and Social Welfare, from which we extracted data on budget allocations and expenditure related to the year 2018. The latter were classified as personnel expenditure, operating expenditure, and current transfers. Data are disaggregated at the level of regional health directorates, hospitals, and PHC facilities. Allocations granted to regional health directorates were excluded from our analysis since they are primarily earmarked for coordinating activities rather than directly financing healthcare provision. Consequently, the analysis focuses on hospital and PHC levels, given the availability of data on public health expenditure and healthcare utilization at the regional level. Merging these datasets using the 'regional' variable facilitates the calculation of average public health expenditure by facility level.

2.4. Variables

The first variable, public health expenditure, was used in part to determine the unit cost of specific services. These data were available yearly and were broken down along hospital and PHC levels. The data did not allow distinguishing between expenditure on outpatient and inpatient care. Annual public health expenditure were broken down at regional level and by level of care (hospital and PHC). We used actual expenditure for operating and current transfers, and budget allocations for personnel expenses. This is because salaries are usually spent with execution rates close to 100%, thus we could assume that budget allocations were equal to actual expenditure. Data were expressed in local currency (CFA franc, with1 EUR = 655.957 FCFA).

The second type of variable, healthcare utilization, was calculated based on two pieces of information: population-at-risk (or eligible population), and actual utilization. In order to match public health expenditure, we did not distinguish between outpatient and inpatient care.

- Population-at-risk (denominator): This comprises the number of occurrences when the surveyed populations expressed a need for care (whether inpatient or outpatient). For outpatients, respondents were asked if they had experienced a health problem, illness, or accident during the 30 days preceding the survey that did not require hospitalization. The question aimed to identify health issues that rather required outpatient consultation. Those who responded affirmatively are considered to have needed care over the preceding month and are thus included in the population-at-risk for outpatient care. Subsequently, respondents were asked about the nature of their health problem, any associated disability, and the duration of the disability. Respondents were also asked about the type of service they utilized, distinguishing between conventional healthcare and

traditional healers. Outpatient needs, which were recorded over a one-month period, were annualized (multiplied by 12). As for inpatients, respondents were asked if they had been hospitalized at least once due to a health problem in the past 12 months (annual variable). Those who responded affirmatively were considered at risk for inpatient care. The total number of occurrences where such needs were identified constitutes the health need variable for the year 2018. In our study, we consider each occurrence of need, be it for outpatient or inpatient services, to be indicative of an individual's inclusion in the population-at-risk. Consequently, an individual may have multiple occurrences of need within a year, thereby being counted multiple times. This approach aims to avoid underestimating the actual needs of the populations. By adding the needs for outpatient care to the needs for hospitalizations, we obtain the population-at-risk.

- Actual utilization (numerator): This refers to the number of occurrences when surveyed populations actually utilized public healthcare services (inpatient or outpatient). Only individuals who utilized public facilities (thus, excluding private ones) were considered, since government transfers are limited to public facilities. For outpatient services, individuals who provided information about the type of service they visited (hospital or PHC) were included. For inpatients, individuals were asked about the type of illness, associated disability, number of hospitalizations, and the type of facility utilized. By summing up the outpatient and inpatient utilization figures, we obtained the actual utilization of public healthcare services. As mentioned above, outpatient needs expressed over a one-month period were annualized, but inpatient visits were recorded on a yearly basis. The ratio of actual utilization to the population at risk gives the utilization rate.

Since health expenditure data were available at national scale (whole population) while healthcare need and utilization data were available at the EHCVM sample scale, to ensure comparability, we had to scale up the survey data to the national population. To do so, we first calculated the number of users at household level, and then used the 'household' weighting to scale up data to the national population. We also used the total annual household consumption expenditure (food and non-food) for the year 2018 as a proxy for the living standard of households. The latter were ranked in five quintiles from the poorest to the richest. Finally, we analyzed the regional disparities regarding average benefits of health service utilization between areas of residence and regions.

Table 1
Healthcare needs and utilization rate of health facilities by region in 2018 (Source: Authors' calculations).

Region	Expression of needs	Utilization rate		Share in total users	
		Hospital %	PHC %	Hospital %	PHC %
Dakar	55,548.81	11	18	19	12
Diourbel	20,308.24	28	24	17	6
Fatick	18,701.97	16	49	9	11
Kaffrine	10,163.11	13	31	4	4
Kaolack	20,812.58	9	48	6	12
Kédougou	4000.00	23	21	3	1
Kolda	10,066.05	8	63	3	8
Louga	10,654.67	9	42	3	6
Matam	11,978.24	18	40	7	6
Saint-louis	13,489.08	11	28	5	5
Sédhiou	96,76.375	12	43	4	5
Tambacounda	10,222.69	25	50	8	6
Thiès	34,961.14	6	35	7	15
Ziguinchor	6955.03	40	38	8	3
Senegal	**237,538.00**	**14**	**34**	**100**	**100**

3. Results

Table 1 presents the number of people who declared having needed healthcare in the 14 regions according to the level of care (hospital and PHC). Scaled up to the national level, an equivalent of 237,538 people expressed the need to seek healthcare over the year, of whom 14% used hospital services and 34% used PHC services. The utilization rate for the Dakar region (11%) represents the number of people who actually resorted to public healthcare in the Dakar region out of the number of people who expressed a healthcare need. Overall, the regions of Dakar and Diourbel concentrate 36% of the hospital level service utilization of the country over the year. These two regions have the particularity of hosting the better equipped health facilities and have a greater population density. As for PHC service utilization, the regions of Dakar, Fatick and Kaolack comprise 12%, 11% and 12% of total users respectively.

3.1. Distribution of benefits by income level

Table 2 shows the results of the average benefit incidence at PHC and hospital levels, for each income quintile.

In the poorest quintile, 40% of individuals used health services at PHC level and 11% at the hospital level. In the wealthiest quintile, 27% of individuals who expressed a need used services at PHC level, and 22% at hospital level. The same reasoning can be applied to other income groups. The results show that out of the total number of users of PHC healthcare services, 23% belonged to the poorest quintile, against 16% to the richest quintile. As for hospital services, 16% of users belonged to the poorest quintile and 32% to the richest (see Table 2). Nevertheless, the share of users in each group out of total service users do not follow a linear trend. For example, concerning the PHC services, the share of users in quintile 3 (24%) was higher than its population size, which is not the case for quintiles 2 and 4. So at this stage, the observed disparities do not allow to conclude on a progressive or regressive trend in benefits (see Fig. 1). At PHC level, although the share of users in the poorest quintile (23%) was greater than its share in the population (20%), they received only 7% of the benefits (as expressed in monetary value), which is equivalent to the proportion of benefits accruing to the richest quintile, and less than the fourth quintile (9%). By contrast, for hospital care, 32% of the total number of users are found in the wealthiest quintile, and its share in benefits amounts to 35%. The service utilization rate and the proportion of benefits accruing to the poorest quintile are lower at hospital than at PHC level. This might explain the

Table 2
Benefit incidence of public health expenditure in 2018 (Source: Authors' calculations).

Primary Health Care				
Quintile	Average benefit (FCFA)	Proportion of benefits (%)	Share in total users (%)	Utilization rate (%)
1	135,000	7	23	40
2	136,000	5	18	31
3	152,000	8	24	41
4	211,000	9	19	33
5	191,000	7	16	27
Senegal	**163,000**	**35**	**100**	**34**
Hospitals				
Quintile	Average benefit (FCFA)	Proportion of benefits (%)	Share in total users (%)	Utilization rate (%)
1	555,000	8	16	11
2	537,000	10	21	15
3	443,000	6	16	11
4	589,000	8	16	11
5	1,270,000	35	32	22
Senegal	**764,000**	**65**	**100**	**14**

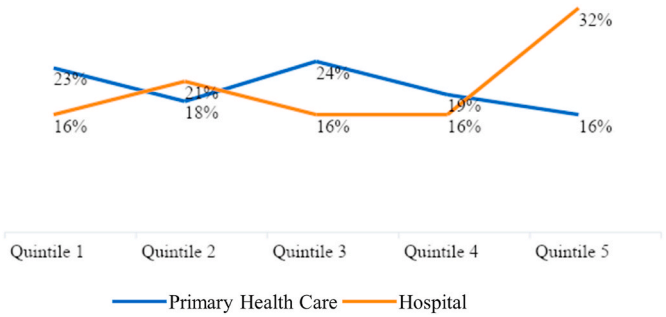

Fig. 1. Share of health services users by income quintile in 2018 (Source: Authors' calculations).

more regressive health expenditure profile observed at hospital level. We use concentration index and curves in the next subsection to conclude on the distribution of benefits (see Table 3, Figs. 2 and 3) .

3.2. Progressivity of benefits: concentration index and curves

According to our results, the benefits resulting from public health expenditure and healthcare utilization were more concentrated in urban than in rural areas, both for PHC and hospital services. This pro-rich distribution was more evident at the hospital level, with a concentration index of 0.615 in urban areas against 0.328 in rural areas (see Table 3). Visualization of the concentration curves confirms these results. In any case, the inequality was more accentuated than that of the distribution of income.

As depicted in Figs. 2 and 3, the concentration curves of care (both at hospital and PHC levels) lie above the equal distribution line (in blue), which indicates that public expenditure is regressive. The pro-rich nature of public health expenditure is more accentuated in urban areas (red curve) than in rural areas (yellow curve). This trend is even stronger at hospital level.

3.3. Distribution of benefits between and within regions

The regional distribution of benefits was also unequal: 11% of the benefits derived from PHC healthcare utilization and 38% of the benefits at the hospital level accrued to the Dakar region. The region of Fatick, which concentrated 12% of PHC healthcare users, only benefitted from 2% of the public health expenditure benefits. The same trend is observed for the regions of Thiès and Kaolack. In other words, for a similar share of actual users in total users at the national level, the region of Dakar captured six times more benefits from public health expenditure than the regions of Fatick and Kaolack, and twice as much as the region of Thiès. At the hospital level, this unequal distribution was even more accentuated. For example, the region of Dakar, which concentrated 19%

Table 3
Summary of concentration indices according to area of residence in 2018 (Source: Authors' calculations).

Primary Health Care		
Area of residence	Concentration index	Standard error
Urban	0.472	0.002
Rural	0.278	0.004
Senegal	**0.464**	**0.002**
Hospitals		
Area of residence	Concentration index	Standard error
Urban	0.615	0.005
Rural	0.328	0.004
Senegal	**0.653**	**0.002**

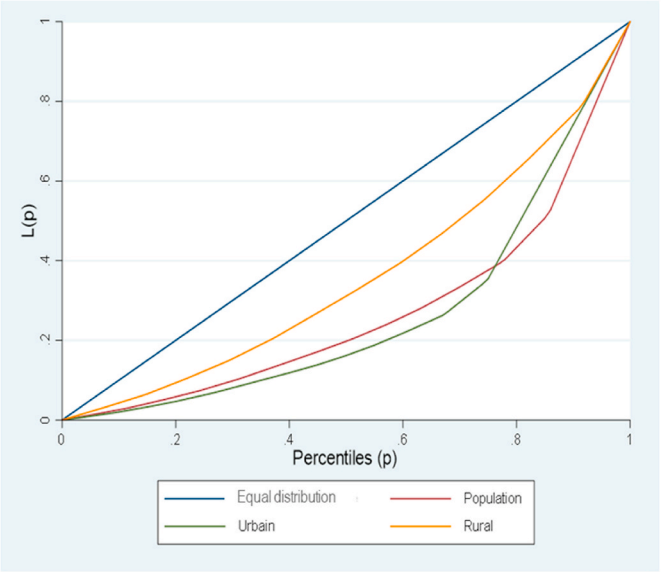

Fig. 2. Progressivity of health expenditure in 2018 (PHC).

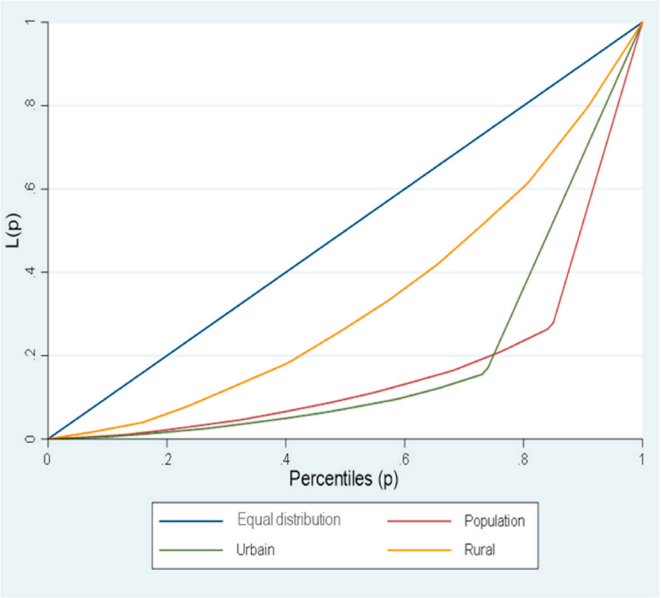

Fig. 3. Progressivity of health expenditure in 2018 (hospitals).

of the hospital care users, captured 38% of public health expenditure benefits. As for the region of Diourbel, it concentrated 17% of users (close to 19% in Dakar) but only captured only 4% of the public health expenditure benefits (Fig. 4). These results also hide disparities in the distribution of benefits within regions, in terms of socioeconomic groups. Figs. 5 and 6 visualize the absolute inequalities in the distribution of benefits between quintiles in each region at PHC and hospital levels, respectively. At the hospital level, the 5th quintile of the region of Dakar captures a significantly higher average benefit than the other quintiles. It constitutes an outlier in the graphical representation and hides disparities in other regions. We thus removed it from the graph to better visualize absolute inequalities in the other regions. The same applies to the Kédougou region at PHC level. Both graphs show that while the disparities are considerable in some regions (Dakar, Louga, and Ziguinchor for PHC level), they are less pronounced in others (Kolda and Sédhiou). The same observation applies to the hospital level.

Of the urban populations having declared a need, only 29% used

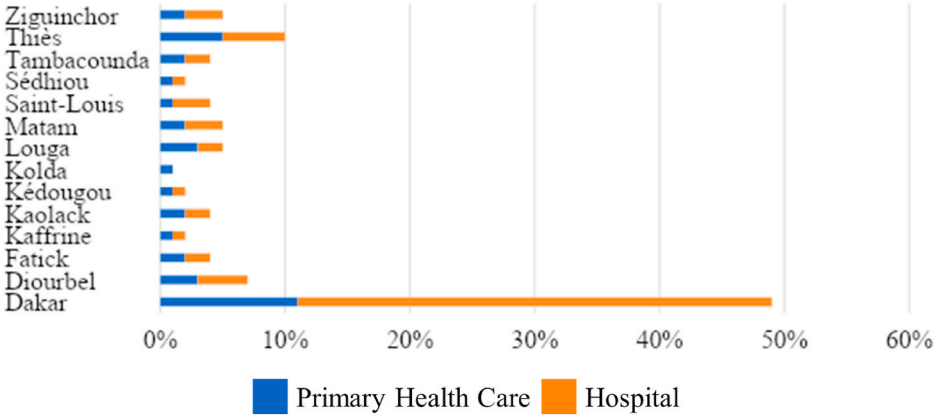

Fig. 4. Benefit breakdown by administrative region in 2018.

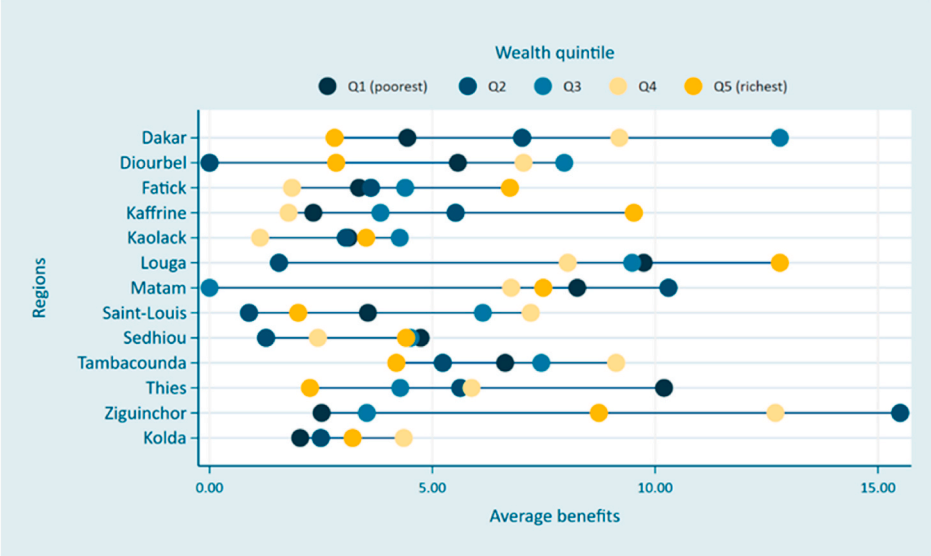

Fig. 5. Distribution of benefits between quintiles per region in 2018 (divided by 10,000 FCFA) (PHC level).

Fig. 6. Distribution of benefits between quintiles per region in 2018 (divided by 10,000 FCFA) (hospitals).

healthcare services at PHC level and 14.3% at hospital level. As for rural populations, these values were respectively 40.7% at PHC and 13.7% at hospital level. Furthermore, of all PHC healthcare users, 54.8% resided in rural areas. Regarding hospital care, rural areas concentrated 45.3% of users. This is not surprising considering that there are more hospitals in urban than in rural areas. However, even though there were more PHC care users in rural than in urban areas, the proportion of benefits went the opposite direction: 19.7% of benefits accrued to urban areas against 14.9% to rural areas. This disparity was even more accentuated for hospital care, for which 52% of benefits accrued to urban areas against 13% to rural areas (Table 4).

3.4. Marginal benefit incidence

Table 5 presents the results from our marginal benefit incidence analysis. It shows that a 1% increase in health expenditure at PHC and hospital level would result in an increase in utilization rates of 0.90% and 1.02% respectively for the poorest quintile, against 1.22% and 1.12% respectively for the richest quintile.

This means that the wealthiest quintile would benefit more than proportionally from an increase in subsidies granted to public health facilities. Even if the poorest benefitted more than the average from an increase in public health expenditure at hospital level, their marginal benefit would be lower than that of the richest quintile. The distribution of the benefits resulting from an increase in health expenditure appears to be pro-rich for both levels.

4. Discussion

This analysis postulated that public health expenditure should ideally be pro-poor to correct the disparities in utilization of healthcare between socioeconomic groups. The results from the BIA in the Senegalese context invalidated this hypothesis. Like a number of others, this study showed an unequal and inequitable distribution of benefits resulting from the utilization of healthcare in public health facilities in Senegal. Such inequities are found between socioeconomic groups, between administrative regions, according to area of residence, and this regardless of the level of healthcare considered. Expenditure at hospital level is even more pro-rich.

The results of benefit incidence analyses carried out in the literature are mixed and particularly dependent on the context, the methods and the data used. But there is a convergence of opinions on the pro-rich nature of public health expenditure in LMICs, especially at the highest level of care. In line with this study, the results of the systematic review of the literature carried out by Chu et al. (2000) showed that public health expenditure was poorly targeted, particularly in sub-Saharan Africa and at hospital level (Chu et al., 2000). A study conducted in India concluded that there was a pro-rich distribution of public health expenditure, with large disparities between states (Bowser et al., 2019).

Table 4
Utilization rate and distribution of benefits by area of residence in 2018 (Source: Authors' calculations).

Primary Health Care			
Area	Utilization rate %	Share in total users %	Proportion of benefits %
Urban	29.0	45.2	20.0
Rural	40.7	54.8	15.0
Total	**34.0**	**100.0**	**35.0**
Hospitals			
Area	Utilization rate %	Share in total users %	Proportion of benefits %
Urban	14.3	54.7	52.0
Rural	13.7	45.3	13.0
Total	**14.0**	**100.0**	**65.0**

Table 5
Results of the marginal benefit analysis (Source: Authors' calculations following the parametric approach of Ajwad and Wodon (2011)).

Quintile	Normalized marginal benefits	
	PHC	Hospital
1	0.902	1.027
2	0.885	0.568
3	0.907	1.685
4	1.086	0.596
5	1.22	1.123
Mean	**1**	**1**

The authors concluded that hospitalizations significantly benefitted the rich more than the poor. Another systematic literature review on the outcomes of BIAs in LMICs also supports the findings of this research: the authors highlighted an unequal distribution of benefits in favor of the rich (Asante et al., 2016). However, in most cases, contrary to the results obtained in the Senegalese context, the distribution of benefits was pro-poor at the PHC level. At the hospital level, the distribution of benefits favored the richest, be it in sub-Saharan Africa, in Latin America and in the Asia-Pacific region, except for Thailand, Malaysia and Sri Lanka. Public health subsidies granted at the primary level are more equitably distributed than at the secondary and tertiary levels. In this study, we conclude that public expenditure on primary healthcare was less regressive, which is not surprising given that the cost of services is lower there.

The high concentration of benefits in favor of the rich at hospital level is probably because care is more expensive at that level. Therefore, in the absence of health insurance, only those who have the capacity of paying for imaging, drugs, etc., could access them (i.e., the wealthiest). Indeed, Table 1 shows that 89% of individuals belonging to the poorest quintile and having expressed a need, have not accessed hospital care, compared to 78% in the richest quintile. By contrast, PHC care seemed to attract more the poorest. Of the total respondents who expressed a health need and belonging to the poorest quintile, 40% used PHC services against 27% for the richest quintile, even if the latter got a higher share of the benefits. The low utilization of public health services by the poorest quintiles may also be partly explained by their reliance on traditional healers. The survey data shows that the two lowest quintiles resorted to traditional healers far more often than richer quintiles (Agence Nationale de la statistique et de la démographie, 2021).

There were also wide disparities in the distribution of benefits between regions. The regions of Dakar and Diourbel monopolized a third of benefits. This could be explained by the high concentration of national and regional university hospitals in the Dakar region, and a higher technical platform in hospitals located in the city of Touba (Senegal's largest holy city). Indeed, our results show that the other regions benefitted slightly (with a maximum of 5% for the region of Thiès) from the hospital-level health expenditure benefits. Another study conducted in India similarly showed wide regional disparities (Bowser et al., 2019).

Because "simple" BIA cannot infer the extent to which increased expenditure could benefit various socioeconomic groups, this research used marginal incidence analysis. The results of the micro-simulations showed that an increase in public health expenditure would not result in a pro-poor distribution, both for PHC and hospitals. These results differ from those of other studies conducted in Kenya and Nigeria, which found that the poor benefitted more than the rich from increased health expenditure at the PHC level (Alabi and Adams, 2014; Gaddis & Demery, 2012).

In summary, the results of this study showed that the allocation of public resources reinforced health inequities. Despite the policy objective of public authorities to promote an equitable health system, there remain wide socio-economic and geographic disparities in access to care. Despite the extension of health insurance, financial barriers continue to penalize poor households by restricting their access to care

at all levels of the health pyramid. Other barriers may also be at play, such as cultural beliefs contributing to refusal to seek healthcare in certain contexts (Ilboudo et al., 2016).

We showed that the better off were more likely to have access to both outpatient and hospital care. The generalization of health insurance to all sections of the population could contribute to address this problem. Furthermore, efforts should be strengthened to guarantee regional equity in the allocation of resources (Paul et al., 2019). This could relieve congestion in major hospital hubs such as Dakar and Touba, and possibly contribute to achieving efficiency gains. Moreover, the indirect costs of poor health (transportation of patients, loss of income for accompanying persons) would be reduced to the benefit of populations of these areas.

5. Conclusion

It is generally accepted that government should undertake evidence-based reforms. The analysis of the progressivity of public health expenditure benefits is a prerequisite for a better allocation of resource, especially in resource constrained contexts. To our knowledge, this BIA is the first to have been conducted in the Senegalese context. It also has the particularity of carrying out a dynamic analysis of the distribution of benefits between socioeconomic strata. This study has several limitations. The first one stems from data constraints. Healthcare utilization data in EHCVM surveys are based on self-reported recent illnesses, which may lead to underestimations of healthcare utilization. Additionally, annual visits calculated from household surveys may be subject to reporting biases based on the timing of data collection relative to seasonal variations in disease prevalence. Future research should aim to address these limitations to provide a more comprehensive understanding of healthcare utilization patterns. Despite these limitations, this paper contributes to new evidence on equity in Senegal. The results underscore significant disparities in resource allocation between and within administrative regions and highlight a pro-rich distribution of public health expenditure. Overall, these findings emphasize the importance of implementing targeted interventions to mitigate disparities in healthcare benefit distribution, both within and between regions. They underscore the need to address disparities in healthcare access and benefit distribution between urban and rural areas. Moreover, the findings suggest that increasing public health expenditure may not effectively address these disparities under current conditions. Therefore, Senegalese policymakers should prioritize the establishment of robust information resources to monitor health inequities effectively. This, in turn, would enable a better targeted allocation of government resources to address the needs of most disadvantaged populations.

Ethics statement

We used secondary data from "*Enquête harmonisée sur les conditions de vie des ménages*" provided by the *Agence Nationale de la Statistique et de la Démographie*. The dataset did not contain any individual identification information.

Data availability

Data on household living standard were provided by the "*Agence Nationale de la Statistique et de la Démographie*" and may be shared by the agency under reasonable request. Data on health expenditures were provided by the Equipment and Administration Department of Senegalese Ministry of Health and Social Welfare but are confidential.

CRediT authorship contribution statement

Mouhamed Samba: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Ibrahima Thiam:** Writing – review & editing, Validation, Supervision. **Elisabeth Paul:** Writing – review & editing, Validation, Supervision.

Declaration of competing interest

None.

Data availability

The authors do not have permission to share data.

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