Socio-economic and spatial trends in child and maternal health care inequalities in Cameroon: a uni- and multidimensional analysis

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ABSTRACT: **Background**: In developing economies, a number of investigations have highlighted the fact that the increase in health expenditure will only contribute to poverty reduction if such expenditure is efficient and if access to health services becomes more equitable. This paper measured inequality trends in maternal and child health services access and use based on socioeconomic and regional characteristics in Cameroon where health policies were redirected in the 90s with more focus on the improvement of equity.

Methods: Using data from Demographic and Health Surveys (1991, 1998 and 2004), the relationship between socio-economic status (SES) and health inequalities was assessed. Concentration Index (CI) and an accurate estimate built from the capability theory were used to measure inequality trends in SES by regions and regional disparities in terms of health services provision, utilization, and outcomes.

Results: The relevant policies and interventions have been more effective in reaching the better-off than the worst-off. Increase in total health care access and use were detected for both variables (immunization - three DPT -, and assistance at delivery by a trained attendant) with CIs showing improved movements through equal distribution. This observation was contradicted by Lorenz curve for assistance at delivery. Trend differentials observed from capability-based health index reveal a significant correlation between health outcomes, deprivation and geographic affiliation.

Conclusions: Maternal and child health services access and use are determined by both socio-economic status (household wealth) and a number of factors including governance (resource allocation) and contextual factors (geographic and socio-cultural). In such context, improvements in the monitoring of health care distribution is important to be carry out at both national and sub-national levels, especially in developing countries that have undergone decentralization and where socio-cultural factors may greatly differ from one region to another.

Key-words: health policies, capability approach, equity, concentration index, health index, Cameroon.

1. Issues and significance of the problem

While the health-related macroeconomic indicators have improved in Cameroon since the recovery measures following the economic crisis (1985-1995) and the 1990s health policies reforms, there have been major concerns about increasing inequity in access to health care for the overall population. This stands as a serious policy matter as population inaccessibility to basic health care affects both social and economic activities by reducing their performance and ability at work, which in consequence seriously jeopardize efforts to restore productivity and economic balance. Only a limited number of studies have analyzed socio-economic disparities in health from reliable quantitative evaluation in terms of either health status or access to care even though there is a growing interest to provide policy-makers with evidences for decision making. Growing evidences suggest that low socioeconomic status is highly correlated to poorer health. But, focusing exclusively on the gap between richest and the poorest fails to draw attention to the social gradient in health as well as the appraisal of contributing factors in a board spectrum.

A number of studies have highlighted various factors that determine the accessibility and utilization of maternal and child health services in developing countries. These factors include the availability (Sahn and Alderman 1997), the geographic accessibility and financial barriers (Arnand, 2004; Waters, 2004; Yiengprugsawan et al., 2007), and the quality of services (Akin and Hutchinson, 1999) as well as characteristics of the users and community in which they live (Jaffre, 2000; Gwatkin et al., 2004). Specifically, this may include distance to health service, cost of service, technical qualifications of health practitioners, socioeconomic status of the users, and women autonomy in household decision-making. Eliminating inequalities means addressing these factors, and it raises concern on measures used to estimate health inequalities, especially in

sub-Saharan African countries like Cameroon. Thus, this paper has both a methodological and an empirical goal.

The fact that inequality is a relative concept raises a couple of interesting questions that will help understand the rationale of such research. Assuming we are interested in the idea of relative levels of well-being, why concern ourselves with the distribution of health, and not just the distribution of income, which is the normal metric for examining inequality? Why should we worry about "relative" health status, beyond being concerned with the absolute level of health?

2. On the measurement of health inequalities in developing context: background and challenges

In developing economies, empirical evidences have consistently shown that despite the implementation of a series of reforms since the 1980s in achieving equity in health care access and use, widespread inequalities within and between societies remain high, even though the countries have been trying to adjust their development policies from "GDP-led" to "people-centred". These studies have led to the conclusion that lower socioeconomic status (SES) is associated with poorer health on a graded rather than a threshold effect (Kakwani *et al*., 1997; Gwatkin *et al*., 2004). Thus, differences in health are apparent along many dimensions including age group, geographic area and SES, and urge improvement in targeting and methodologies applied to analyze health inequalities as these appear to be key constraints in public policies formulation, monitoring of implementation and evaluation (Wagstaff and van Doorslaer, 2000 ; Nkwenkeu *et al.*, 2002).

The money metrics traditionally used to evaluate policies, especially health-related policies are still based on

conventional one-dimension focused income indicators – GDP, income *per capita* or expenditure – and are therefore not able to capture neither the spatial specificities nor the multidimensional aspects of poverty and health. This relative lack of multidimensional assessment to track structural inequalities, especially in sub-Sahara african countries can be one of the reasons explaining the poor performance of public policies both in terms of efficacy and equity (Castro-Leal *et al*., 2000; World Bank, 2005; Nkwenkeu, 2010). To date, evaluation of health policies tend to focus mostly on questions of equal access in health care and public health expenditures rather than on the distribution of health across population subgroups (Braveman, 1998; Arnand, 2004; Yiengprugsawan *et al*., 2007) which is vital to generating essential information on equity for policy decisions.

The measurements of socioeconomic inequalities in health strongly vary in complexity and differ in at least two ways: (i) whether they measure relative or absolute differences in health, and (ii) whether they measure distribution of inequality through simple or sophisticated techniques. For the first category, measurement can be expressed as a relative difference (rate ratio) or as an absolute difference (difference in rates). For the second, calculations and interpretations deal with more sophisticated regression-based techniques to summarize the magnitude of inequalities across population subgroups. These include summary indices as the relative index of inequality, and the *health concentration index* (CI) which is calculated in a similar fashion to the Lorenz curve and Gini coefficient, and include both the magnitude and the total population distribution of inequality (Wagstaff *et al.*, 1991; Harper and Lynch, 2005; Gwatkin *et al.*, 2007). Both set of

measures are to be considered since absolute measures are important for decision-makers, especially when goals in absolute terms have been set, because they allow a better appraisal of the magnitude of public health problems, while measure of the distribution of health is more likely to capture inequality in a broad range of dimensions.

Given the limitations of the one-dimensional approach for poverty analysis, Sen (1980) proposed the capability approach (CA, henceforth) which states that the space of *capabilities* is more appropriate to an evaluation of inequality than the space of *utilities* or that of *primary goods* as suggested by Bentham (1789, cited by Sen, 1992) and Rawls (1971), respectively. Sen's capability approach assesses individual's well-being in terms of 'capability sets' that describe the set of all possible functioning vectors that a person can achieve. The capability set is obtained by applying all feasible utilizations to all possible choices of commodity characteristic vectors (Sen, 1985; 1987) as it is connected to human freedom instead of human productivity. Applying the approach in the measurement of health inequalities implies analysis of health status in a broader context along with other dimensions of social arrangements, and more specifically, the overall allocation of resources to health and the utilization of health services.

Sen's theory of development puts human well-being in the forefront of development goals. Viewed in this light, the causal linkage between development, capability and inequality become evident although its critical aspect remains the subjective creation and interpretation of capability sets. This has engaged a diverse range of researches for its proper application in the area of development in the 1990s (Cerioli and Zani, 1990; Alkire

and Ravallion, 1993; Cheli and Lemmi, 1995; Dolan *et al.*, 1996; Chiappero, 1996; Alkire, 1998). In a very short while, the *CA* gained its greatest revival and started influencing development policies toward poverty measurement. It is within this context that a Multidimensional Poverty Index (MPI) that complements the traditional focus on income to reflect the deprivations that a poor person faces with respect to education, health and living standard emerged and is currently being used by the United Nations to rank countries in term of quality of life. This quantitative approach based on aggregated data has become widespread and has lead to the construction of a number of indices: e.g. gender related development index, gender empowerment measure, etc. (UNDP, 2005).

Against this background, a number of concerns are being raised on how the CA can be applied to the evaluation of development policies and programmes (McGuire, 2001; Cookson, 2004; Bangolin and Avila, 2006). Specifically for health, there is no perfect workable evaluation metric at the moment to apprehend the overall health status, given the multidimensional aspects of health and the plurality of its determinants. Such situation stands as a matter of concern for health policies, especially in developing countries.

This study intends to contribute to improving our understanding of differentials in the application of two approaches (one-dimensional and multi-dimensional) in a developing context. It conveys an important policy implication since it is related to whether health inequalities across population subgroups simply reflect inequalities between income groups (classified according to individual income from the lowest to the highest income groups equivalent to the 1^{st} quintile and the 5^{th} quintile) or more

significantly, suggest a contextual effect due to factors beyond the control of individuals (health supply) and individual 'free choices' (health demand), or a bit of both?

The purpose of this paper is therefore two-fold: (i) first, to use a health concentration index coupled with concentration curves to appraise the socioeconomic distribution of health in the population and second; (ii) the application of a *fuzzy* entities calculation (health index) to measure basic capabilities related to health where interactions among investments in health (supply side), human capital and human capabilities (demand side) are intertwined.

For illustrative proposes, we considered quantitative data from nationally representative Demographic and Health Surveys conducted in Cameroon where health policies were redirected in the 90s with more focus on improvement of equity in health care access and use, as enshrined in its Primary Health Care strategy. Furthermore, it is also important to note that both the country's health policy framework and Poverty Reduction Strategy Paper (PRSP) commit the government to improve health outcomes of the poor and disadvantaged through appropriate resources allocation and services (MoH, 2001; PRSP, 2003) towards the achievements of the Millennium Development Goals (MDGs).

3. Data, variables and methods

3.1. Data

The data used for the study to monitor socioeconomic inequalities in health were obtained from three 'Demographic and Health Surveys' conducted in Cameroon (DHS 1991, 1998 and 2004) by the National Institute of Statistics, with technical assistance from Macro International Inc. These surveys collected data from nationally representative samples of households and include 4,685 respondents (3,538 households) in 1991, 8,063 respondents (4,697 households) in 1998, and 15,936 respondents (10,462 households) in 2004. The surveys were based on the same characteristics and results are therefore comparable.

Despite the wealth of information inherent to DHS, their use entails some analytical constraints, especially when poverty had to be assessed. Indeed, the DHS of Cameroon - like most of the DHS - do not collect information on households' expenditures or income. Thus, it is impossible to take into account, for example, *per capita* consumption as an indicator of living standards. Under these circumstances, we consider household living standard from some of their owned assets - except lands - which provide an alternative welfare measure. Thus, a set of asset-based variables were used as proxies for household income/consumption which were further weighted using the principal components analysis (PCA) method to classify mothers into socioeconomic quintiles (Gwatkin *et al.*, 2007; Filmer and Pritchett, 2001).

3.2. Variables

We focused on two dependent variables from the three frequently identified as critical for child and maternal health (immunization – DPT3[1] – and, institutional delivery – assistance at delivery by a trained professional). To build the health index, the under-five mortality rate – U5MR – was used as a 'functioning vector' as shown in table 1.

For independent variables, an asset-based index was used as proxy of *per capita* household income/consumption to measure household wealth. It is a categorical measure which distinguishes five-category variables grouped into five quintiles (Q1 for the 20% poorest, Q2 for the 20% poorer, Q3 for the 20% middle, Q4 for the 20% richer and Q5 for the 20% richest). The *region of residence* was included in the analytical model to assess the effects of location on health distribution and outcome to appraise regional disparities.

3.3. Analytical framework

3.3.1. Measuring health inequalities through concentration index: a one-dimensional approach

In this study, we used the *health concentration index* proposed by Wagstaff *et al*. (1991) to measure the relative income-related health inequalities. This measure derived from information on the distribution of health across

[1] Three consecutive doses of Diphtheria, Pertussis , and Tetanus vaccine

income groups in the form of either a continuous or a dichotomous variable. It meets the three minimum requirements to appraise socioeconomic health inequalities: (i) reflects the socioeconomic dimension to health inequalities; (ii) reflects the experiences of an entire population; (iii) sensitive to changes in the distribution of the population across socioeconomic groups (Wagstaff *et al*., 1991; Humphris & van Doorslear, 2000). The *CI* can be written in various ways, but one of the most cited which can be computed straightforwardly on individual-level data is:

$$CI = \frac{2}{n\mu}\sum_{i=1}^{n} h_i R_i - 1 - \frac{1}{n}$$

Where:

- h_i is the health variable of interest for the i*th* person;
- μ is the mean of h, which can be structured as $\mu = \frac{1}{n}\sum_{i=1}^{n} h_i$;
- R_i is the i*th*-ranked individual in the socioeconomic distribution from the most disadvantaged (i.e., poorest) to the least disadvantaged (i.e., richest);
- n is the number of persons.

CI summarizes measures indicating whether the health is concentrated more at a lower or a higher socioeconomic level. The minimum and maximum values of *CI* using individual-level data are -1 and +1: these occur when all the

population's health is concentrated at the highest and least disadvantaged groups respectively. If there is no inequality, it equals 0.

To illustrate health inequalities empirically, we drew for each variable a concentration curve, also known as Lorenz curve *L*(*s*) that plots the cumulative proportion of the population (ranked by income, beginning with the lowest incomes) against the cumulative proportion of health outcome. If *L(s)* coincides with the diagonal (called 45˚curve or line of equality), everyone enjoys the same health. If *L(s)* lies below the diagonal, inequalities in health exist and favor the richer members of society. The further *L(s)* lays from the diagonal, the greater the degree of inequality. *CI* is defined as twice the area between *L(s)* and the diagonal.

3.3.2. Measuring health inequalities through a multidimensional health index

We founded our approach on Human Poverty Index for developing countries, which is a composite index based on three dimensions – health (longevity), education (literacy rate) and resource (standard of living) – as shown below (Tsudhir and Sen, 1994; UNDP, 1995).

$$\mathrm{HPI} = \left[\frac{1}{3}\left(P_1^{\,3} + P_2^{\,3} + P_3^{\,3}\right)\right]^{1/3}$$

Where:

- P_1 is the probability at birth of not surviving to age 40 (times 100);
- P_2 is the adult illiteracy rate;

- P_3 is the unweighted average population not using an improved water source and children underweight-for-age.

This was applied to the health index by assessing the 'chosen functioning vectors' from both health supply (health services provision) and health demand (health services utilization – participation, and health outcomes) sides. Each functioning vector gives a possible state of 'being' in order to capture deprivation in relation to health outcomes.

The health index was built from three main indicators: the health services supply, the infant mortality and the health services utilization. The first measures the availability of beds and doctors per thousand inhabitants (HSI). The demand for beds and physicians concerns the inducement hypothesis which states that « *an increase in the supply of beds and doctors generates a corresponding demand for their services* » (Rice and Labelle, 1989). The second and the third indicators measure the outcomes of the health care policy within the total population reflected by the infant mortality (IMI) and the service utilization index (SUI), respectively. We based our choice from the assumption that once the fair distribution of health is defined, a health production function can inform on the exact distribution of health care that would accomplish the equity objective. It thus establishes a causal relation between the amount of health care received and the health status attained.

The aggregated health index is provided from the three sub-indexes (HSI, IMI, SUI), with each weighing 1/3.

$$HI = \frac{1}{3}(HSI + IMI + SUI)$$

The health supply index is an aggregated intermediate index of the beds supply and the doctors supply sub-indexes, each having the weight of ½ in the final health supply index. The same calculation is done for the Service Utilization Index (SUI) using DPT3 coverage (SU_{DPT3}) and institutional delivery (SU_{ID}). To define thresholds, we used parameters recommended by the World Health Organization (WHO, 2006) which considers as reasonable numbers 4.5 beds per thousand people and 1 doctor per ten thousand people. The parameters where built using international average. For other sub-indexes, the minimum and maximum values were defined from the classification of the 2005 monitoring of the situation of children and women (UNICEF, 2005). The averages rates were obtained from the 15 countries top and last in terms of classification. The formulas for health service provision and health service utilization indexes calculation are therefore:

$$HS = \frac{1}{2}(HS_{beds} + HS_{doctors}) \text{ and } SU = \frac{1}{2}(SU_{DPT3} + SU_{ID})$$

The health index can then be mathematically represented as follows:

$$HI = \frac{1}{3}\left[\frac{HS_{beds} + HS_{doctors}}{2} + IMI + \frac{SU_{DPT3} + SU_{ID}}{2}\right]$$

All sub-indexes were calculated using a linear fuzzy function with the following specifications:

$$\mu_A(x) = \begin{bmatrix} 0 & if & x \leq x_{min} \\ \dfrac{(x - x_{min})}{(x_{max} - x_{min})} & if & x_{min} < x < x_{max} \\ 1 & if & x \geq x_{max} \end{bmatrix}$$

Table 1: Selected capability sets and corresponding functioning vectors

Capability set	**Functioning vector**	**Thresholds values**	x_{min}	x_{max}
Supply side : health services	Beds supply	4.5 per thousand people (WHO, 2005)	1.5	7.5
	Doctors supply	1 per ten thousand people (WHO, 2005)	0	2
Demand side : health services utilization	DPT3 coverage	calculated from the average data of the 15 African countries with best and worst performance	31.1	79.6
	Institutional delivery		25.5	74.6
Demand side : health outcomes	U5 children mortality[2]		83.4	204.9

[2] For Infant mortality, the index calculation becomes:

$$\mu_A(x) = \begin{bmatrix} 0 & if & x \geq 204.9 \\ \dfrac{(x - 204.9)}{(83.4 - 204.9)} & if & 83.4 < x < 204.9 \\ 1 & if & x < 83.4 \end{bmatrix}$$

3.4. Statistical analysis

All analyses were conducted separately for the 1991, 1998 and 2004 surveys instead of pooling the data so that the results across the three survey samples can be compared and inequalities trends appraised. Descriptive bivariate results presented were weighted and adjusted for survey data clustering.

Data analysis took place in several stages. The initial stage involved screening of the variables for their distributional properties and implementing appropriate transformations necessary to correct for deviations from a normal dichotomous distribution (yes = 1; otherwise = 0). Initial descriptive properties examined included: mean, upper and lower limits, standard deviation.

4. Results

Table 3 presents the distribution of health care access and use with an important progressive increase from low- to high-SES groups (wealth quintiles), and reveals persistent huge inequalities disadvantageous to those who are deemed poor and near-poor. Because wealth indexes are constructed using quintiles, about one fifth of respondents are distributed across each quintile, even after deletion of cases with missing information. In a normal and equitable distribution, access to health care services is supposed to account for the same percentage in each wealth quintile. This means that all socio-economic groups enjoy the same access to health care services. It is of interest to note that the income-related inequality in health can also be reflected from difference between the poorest (Q1) and the better-offs (Q5). The Q1/Q5 ratio or equity ratio may also play a

significant explanatory role in analyzing inequality by income distribution.

Specifically for basic immunization (three DPT), the figures of 2004 are almost 1.5 times higher in the poorest fifth of the population than in the richest fifth (42.04% for Q1 and 65.34 % for Q5), compared to two times in 1998 (24.43% for Q1 to 58.00 % for Q5). The large difference comes from the distribution of mothers delivering with the assistance of a trained attendant (32.94% for Q1 and 90.02 % for Q5 in 2004 against 34.29% for Q1 to 69.23 % for Q5 in 1998). This leads to the conclusion that although people in lower socioeconomic groups are more exposed to disease and mortality, they still do not necessarily have health care access greater rates.

The increase in equity ratio which reflects the differential between the poorest households compared to the least poor is substantial, rising from 0.37 to 0.58 for DPT3 and from 0.42 to 0.64 for institutional delivery, respectively. Expressed as a difference rather than a rate ratio, access of all wealth quintiles improved from 1998 to 2004. Thus, the distribution of these two health outcomes resulted in an increase in terms of equity ratio, but it does not give any picture for the middle quintiles which represent nearly 60% of the total population.

Table 3: Equity trends in institutional deliveries and DPT3 coverage by wealth quintile in 1998 and 2004.

Dependent variables	*Mean percentages by wealth quintile*					*Equity trends*		
	Q1	***Q2***	***Q3***	***Q4***	***Q5***	***All***	***Poorest to least poor (Q1/Q5 or equity ratio)***	***Q5-Q1 differentials***
1998								
Institutional delivery	32.94 (n=419)	35.86 (n=449)	64.02 (n=428)	84.60 (n=500)	90.02 (n=521)	63.23 (n=2317)	0.37	57.08
DPT3 coverage	24.43 (n=131)	25.40 (n=126)	33.33 (n=135)	45.34 (n=161)	58.00 (n=150)	38.37 (n=701)	0.42	33.57
2004								
Institutional delivery	34.29 (n=1570)	40.18 (n=1812)	58.40 (n=1923)	63.70 (n=1498)	69.23 (n=1116)	59.35 (n=8125)	0.58	34.94
DPT3 coverage	42.04 (n=157)	41.44 (n=181)	45.93 (n=209)	57.97 (n=138)	65.35 (n=101)	48.79 (n=785)	0.64	23.31

4.1. Distribution of health care services measured through concentration indices

From Wagstaff's equation, computed CIs yielded some interesting results as they enable the spatial patterns appraisal of immunization and institutional delivery concentrations across regions. Not surprisingly, the distribution in all regions was found to be inequitable, and for most of them, largely to the disadvantages of the poor. Living in some regions may greatly contribute to inequalities, and perhaps reflecting a much higher level of health access and health services utilization disparities, as CIs clearly show the magnitude of inequalities which strongly varies from one region to another.

Figures 1 and 2 show CIs by regions and over time. If the bar is below the horizontal axis, this means health outcome measured is more concentrated in low-SES groups; inversely, if the bar is above the horizontal axis, it is more concentrated in high-SES groups. The height of the bar corresponds to the severity of inequality. Regarding income-related inequality, except for the Extreme-North (CI = 0.104) and the East (CI = 0.083), the CIs for institutional delivery in 1998 were more concentrated in the high-SES groups, with the regions of Adamaoua, Littoral, Centre and South-West presenting the highest gaps. In 2004, only few regions have shown improved or less steadily movement through equal distribution (Adamaoua, Extreme-North, North, West and South-West).

For DPT3 coverage, all regions have observed significant decrease in socio-economic inequality except the South-West (with a CI of 0.252 in 1998 against 0.420 in 2004). The most controversial, but interesting observation came from the North and North-West regions where immunization turned from favoring the high-SES groups in 1998 to low-SES groups in 2004. However, for the Extreme-North, the direction of inequality reflects a decline

in favor of the poor for both years. The total CIs record modest positive overall concentration indices for each health outcome measured with an increase in pro-poor distribution between 1998 and 2004, especially for trained birth delivery.

Figure 1: Distribution of concentration indices for institutional delivery in 1998 and 2004

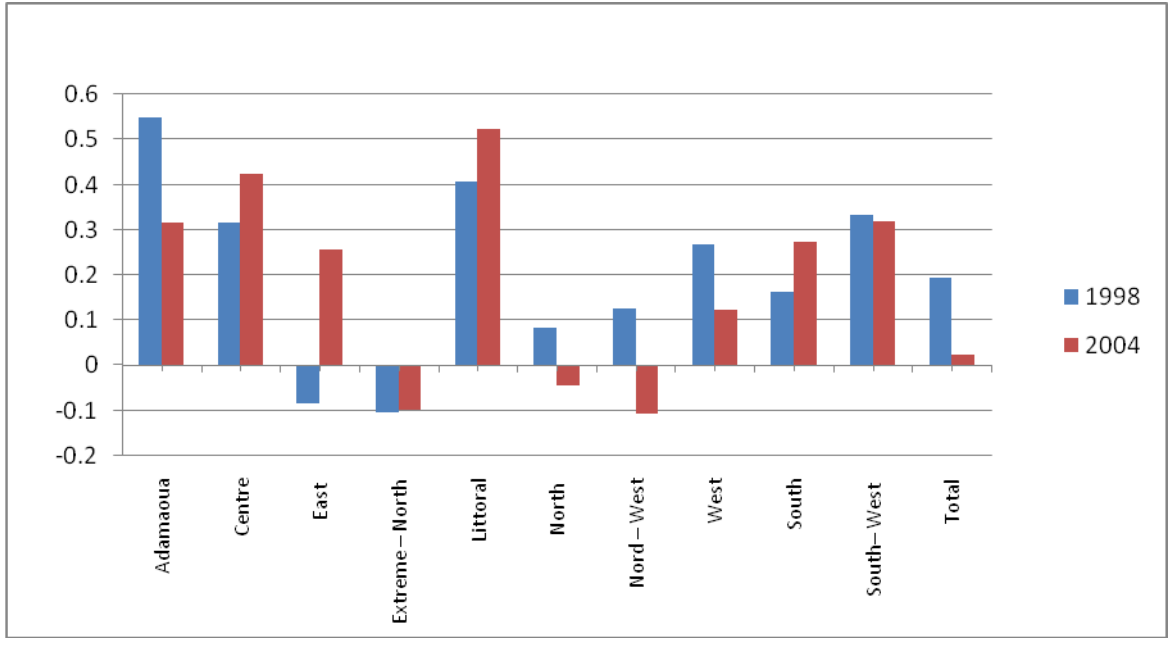
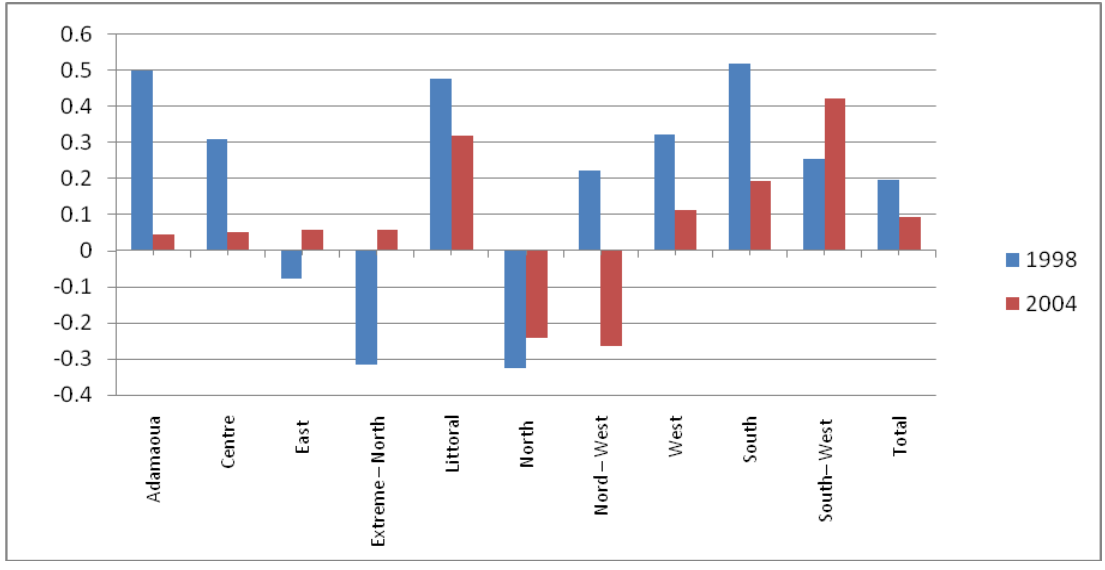


Figure 2: Distribution of concentration indices for DPT3 coverage in 1998 and 2004



Figures 3 and 4 respectively chart the deviations of concentration curves for the two health outcomes from the equidistribution line (45˚ line or line of equality, where the distribution is perfect) in 1991, 1998 and 2004, and confirm trends by showing the extend of inequality from one year to another. From those curves, three main interpretations can be done. Firstly, they are all below the diagonal, indicating a pro-poor inequality (or pro-rich distribution) in access and use over the three years. In other words, whatever the year considered, children and women from poor households have less access to child and maternal health services compared to their counterparts from wealthier households. Secondly, the concentration curve of 2004 is clearly distinguishable from those of 1991 and 1998. For DPT3, the 2004 curve is much closer to the line of equality than those for previous years, which means that inequality was less pronounced in 2004 for immunization coverage, while for institutional delivery, the opposite situation occurred. Thirdly, the 1991 and 1998 curves intersect regularly, indicating that one can not strictly judge the dominance between the two distributions of these years.

To conclude on this point, we can agree that immunization services have walked best in 2004 in a distributive point of view (equity) than in 1991 and 1998 compared to maternal service utilization for which inequality were more pronounced than in the previous years. Thus, the high and rising rates and the persistent rich-poor gap indicate that the implemented health policy have managed to increase average rates, but have not adequately addressed equity. The observation also shapes the gap in interpreting CIs from figures 1 and 2 where total CI for institutional delivery reveals an almost equal distribution in 2004 (CI = 0.023) compared to DPT3 (CI = 0.092) and values obtained for 1998.

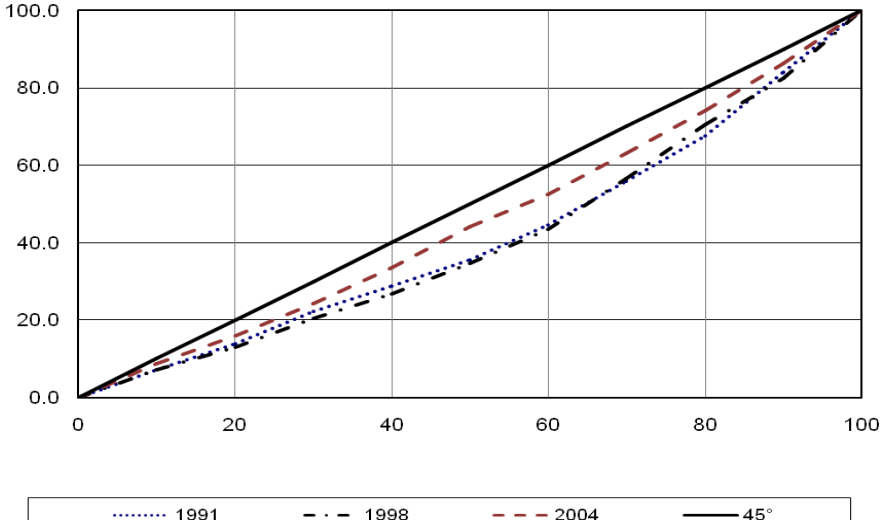


Figure 3 : Concentration curve of access of children (aged 12-23 months) to DPT3

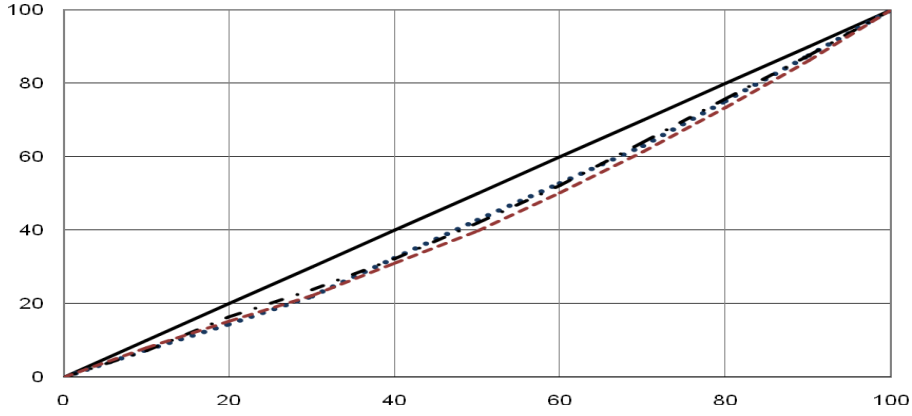


Figure 4 : Concentration curve of assistance at birth by a skilled health personnel

4.2. Multidimensional health inequalities

Since health index is constructed by aggregating 5 functionings, its interpretation can only be done on a scale basis. The challenge at this stage is how to scale such index in a context characterized by widespread poverty, poorest overall indicators and a disturbing picture in terms of morbidity and mortality. The Human Development Index standard classified regions from 0 to 0.49 as poor, those from 0.50 to 0.79 as having a moderate level of poverty and those with a value of 0.80 or above are considered as having low levels of poverty. Willing to facilitate the HI analysis and interpretation, we proposed more comprehensive intervals as no region has had a score of 0.80 or more.

The overall health index significantly increased from 1998 to 2004, moving from 0.35 to 0.51, due to the significant increase in health supply which induced a corresponding demand in health service utilization. From table 5, it can be seen that the supply of health services correlates with its utilization and the under-five mortality. The North region appears as the least ranked with a HI of 0.15, followed by Extreme-North (0.17), Adamaoua (0.39), East (0.44) and South (0.46). Except for the North, all regions present an increase (even slight) from 1998 to 2004.

To allow better visualization of trend differentials as measured through concentration indices and the multidimensional health index, we spatially represented the movement of the distribution from scores obtained in 1998 and 2004 for each dependent variable and for the aggregated health index. From that, we can observe an association between health outcome, poverty and geographic areas. The regions with poor HI are those with severe deprivation and widespread poverty. For the latter,

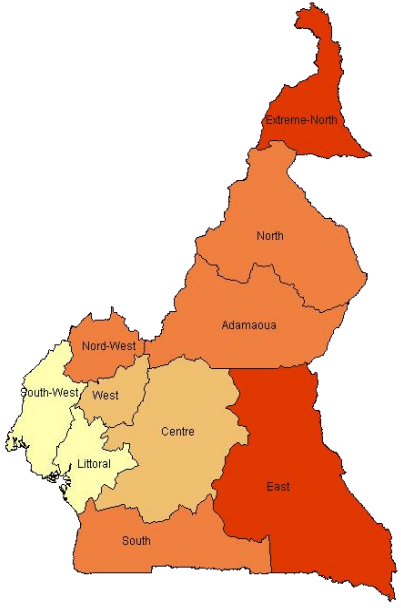
the regions within the same scale seem to be concentrated on a geographical basis.

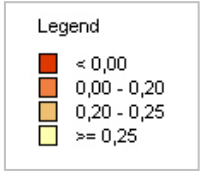
Table 5: Aggregated health indexes in 1998 and 2004.

	1998				2004			
	HSI	IMI	SUI	HI	HSI	IMI	SUI	HI
Regions								
Adamaoua	**0.19**	**0.23**	**0.12**	**0.18**	**0.22**	0.57	**0.37**	**0.39**
Centre	0.46	0.93	0.67	0.69	0.56	0.70	0.85	0.70
East	**0.16**	**0.00**	**0.16**	**0.11**	0.50	**0.15**	**0.66**	**0.44**
Extreme – North	**0.05**	**0.00**	**0.00**	**0.02**	**0.08**	**0.16**	**0.27**	**0.17**
Littoral	0.34	0.90	0.69	0.64	0.50	0.76	1.00	0.75
North	**0.09**	**0.25**	**0.17**	**0.17**	0.33	**0.00**	**0.13**	**0.15**
North – West	0.18	1.00	0.77	0.65	**0.22**	0.87	1.00	0.70
West	0.21	0.97	0.64	0.61	0.33	0.65	1.00	0.66
South	**0.16**	0.60	0.45	0.40	**0.18**	**0.42**	0.77	**0.46**
South– West	0.48	**0.32**	0.59	0.46	0.74	0.50	1.00	0.75
Total	**0.21**	**0.44**	**0.34**	**0.35**	**0.31**	**0.50**	**0.72**	**0.51**

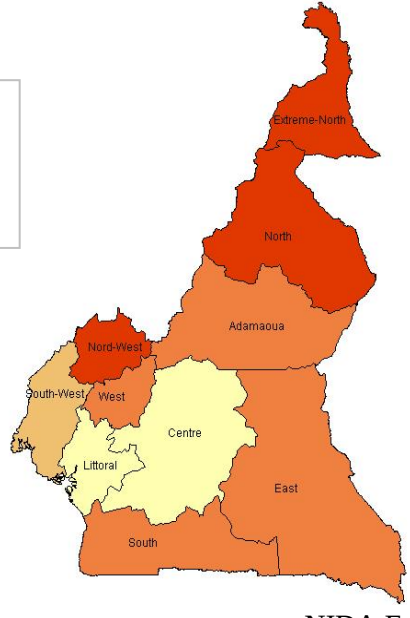
*The values below the means are highlighted

Concentration indices for institutional delivery in





Concentration indices for institutional delivery

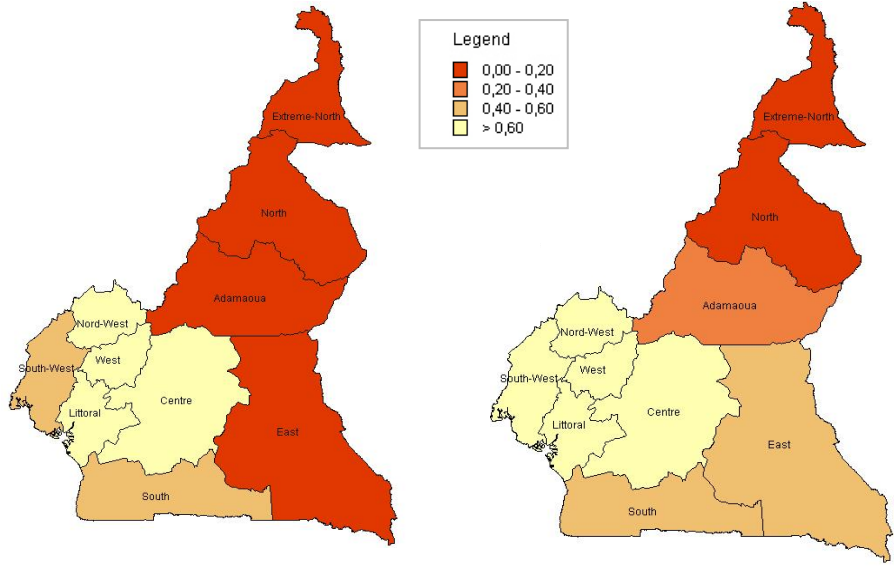


Concentration indices for DPT3 in 1998

Concentration indices for DPT3 in 2004

Aggregated Health index 1998

Aggregated Health index 2004



5. Discussion and conclusions

The literature on equity in health care distinguishes between horizontal and vertical equity (Wagstaff and van Doorslear, 2000; van Doorlear *et al.,* 2002). Horizontal equity assumes that individuals in equal need (in terms of illness) have an equal opportunity to obtain care irrespective of their SES (in terms of access and utilization); whereas vertical equity demands that people with the greatest needs be given the most care, applying the principle of a positive discrimination (unequal, but equitable treatment). For the purposes of this study, equity is defined as equal access to a basic package of services for equal need, where: (i) *need* refers to both the capacity to benefit and the utility of such services in terms of life saving; and (ii) *access* refers to barriers, mainly financial and geographical, faced by potential users, which is in line with the concept of horizontal equity.

Using the CI approach complemented with concentration curves has allowed examining trends in the socio-economic inequality of access to child and maternal health care services and outcomes. Compared with traditional regression analysis, CI has the advantage to include all respondents in its calculation, and generates results that are more sensitive to changes in the socio-economic distribution (Kanjilal *et al*., 2010). However, CI is still limited as it can only be applied if a strict ranking socio-economic variable, like income (assets-based wealth index in this case), is available. Although missing income can bias the value of CI, the effects remain minimal in the present study because the percentage of subjects with missing information was small (Appendix).

Our analysis shows that socio-economic inequality in the distribution of basic immunization and assistance at delivery varied across SES-groups and regions over time and suggests a relationship between SES and health that needs to go beyond simple categorization (e.g. low, middle,

high) to exploit a full spectrum of SES (Mackenbach and Kunst, 1997). Thus, the inclusion of a multidimensional health index in the analysis was designed to shed light of socioeconomic classification gaps by considering a variety of contextual factors that might have an equal or greater impact on health status across regions.

The North and Extreme-North regions appear not only as critical geographic areas (with HIs of 0.15 and 0.17, respectively), they are also regions where no improvement in averages and distribution was found over the reference period. Those regions also correspond to the most deprived as they are known as being worst-off in terms of human development index, followed by Adamaoua, East and South (PRSP, 2003). Health index follows a gradient association with geographic affiliation. The well-off regions clearly appear to be concentrated in the central and western part of the country. These regions (especially Centre and Littoral), are also those having the highest inequalities across different socio-economic indicators (PRSP, 2003). The performance achieved for immunization in the northern regions is certainly the outcome of a conjunction of factors including large scale and high impact interventions such as campaigns and outreach accelerated vaccination programmes which might have reduced the travel time and thus the indirect cost of services users (Nkwenkeu, 2010). This latter aspect conveys an important policy implication, since it is relates to whether health differences across place of residence (rural-urban, regions) simply reflect inequalities between socioeconomic groups or, more significantly, suggest a contextual effect in shaping population health (Kawachi *et al.*, 2002).

The proportions of institutional deliveries have declined for all wealth quintiles even if a slight increase has been observed for the bottom quintile in 2004. As noted

earlier, the probability of services use conveys information mainly on initial visits (during birth), and reveals little about the overall volume and quality of services used (complete or incomplete obstetric services). Both the volume and quality determine the equity measure of health care distribution. Thus, future research should address this issue to generate more information that would allow narrowing the equity gap. In assessing achievements of health policy implementation, it is neither important to think not just about the mean (effectiveness), nor just about inequalities (equity), but about both.

The concern in this study was not so only with inequalities per se but also with the extent to which measured inequality varies according to the weight attached to the variable of interest. A region can do well on one dimension (e.g. immunization) and do badly on the other (e.g. assistance at birth, antenatal or postnatal care). Littoral and Centre regions corresponding respectively to the economic and political capitals have highest HI levels as the most urbanized, but inequalities between the poorest and the better-offs remain very large. The same is true for South-West region. By contrast, North and Extreme-North regions have fairly small gaps between the poor and the better-off while having extremely low HI. These results are consistent with a most recent one conducted in assessing sub-national inequality trends in neonatal and child mortality in Brazil (Souza *et al.*, 2010) and child malnutrition in India (Pathak and Singh, 2009) and raise the importance of MDGs progress monitoring at sub-national level to track structural inequalities and equity gaps to accurately target health and intersectoral policies. Thus, there is a need for evaluators to take into account inequality as well as the average of health status in assessing achievements in the health sector to appraise the overall distribution.

The interesting fact about the capability approach is that, even for the evaluation of a policy or programme covering micro-geographic areas (e.g. health districts, health areas, municipalities, etc.), the spatial distribution of health status can be applied from districts-level databases (reference to the National Health Information System). It also gives a great flexibility in terms of designing the different functionings relevant to the evaluation purpose (underweight, access to insecticide-treated nets – ITNs – and use, prevalence of a disease, etc.).

However, even if several policy implications may arise from this study, there are some issues to be considered, given the limitations of both approaches related to the nature of the data and the techniques applied.

First, while household health surveys are quite common in developing countries, the reliability of data from them for studies of socioeconomic inequalities in health has at times been questioned due to the perception bias as people from different socioeconomic levels may have different perceptions of their health status (Yiengprusawan, 2007). Also, DHS surveys do not collect data on household income or expenditure, the traditional indicators used to measure wealth. The assets-based wealth index used here is only a proxy indicator for household economic status, and it does not always produce results similar to those obtained from direct measurements of income and expenditure where such data are available or can be collected reliably. In addition, the creation of the wealth index rests on assumption that the underlying variables of the indicator are highly correlated (Filmer and Pritchett, 2001 ; Schellenberg *et al*., 2003)

Second, our data indicate that examination of equity should not only be limited to SES (from poorest to

better-offs), but rather look comprehensively at various other factors that might have an equal or greater impact on health outcomes distribution across population groups by considering several contextual factors. Though the varieties of contextual and socio-cultural factors undoubtly weakens socioeconomic classification of health outcomes, a uniform definition of health index in such context cannot capture the large variety of regional situations with wide disparities in terms of economic and social development. Investigating the reasons beyond such situation is far the scope of this work. Nonetheless, the health index appears as a relevant inclusive health outcomes tracker. The HI reveals a systematic difference in overall health levels across regions but do not examine the impact of societal influences on intra-regions health distribution. It is an appropriate summary index which can be introduced in health policies evaluation as a complementary approach that yields consistent information with much flexibility in terms of choosing functioning vectors and scales, but not as an alternative to quantitative inequality measured by CI. Therefore, cultural characteristics and ingrained behaviors which play a significant role should be include where relevant.

Third, it should be recalled that in Cameroon, as in most developing countries, the income measure is not easy because of the high frequency of false statements during data collection, the multiplicity of activities carried out by households members, the great variability in income generated from the non-monetary nature of certain income, etc. Because income and expenditure are difficult and time-consuming to obtain, an alternative to apprehend socioeconomic inequalities in health is to consider households wealth in term of consumption (food, health, education, etc.), an approach that still relies on an unproven ‘no savings’ assumption. But in this case,

evaluators should carefully consider from the outset whether they are concerned with long-term or short-term outcomes, whether the question of interest is related to asset-based inequality, income or expenditure/consumption inequality, the context in which the Policy/Programme is being implemented and the nature of policies that they want to inform.

List of abbreviations

ANC: Antenatal care; CI: Health Concentration Index; DHS: Demographic and Health Survey; DTP: Diphtheria, Pertussis and Tetanus vaccine; HI: Health Index; IMI: Infant Mortality Index; MDG: Millennium Development Goal; HIS: Health Supply Index; MoH: Ministry of Health; SES: Socio-economic status; SUI: Service Utilization Index; PCA: Principal Component Analysis; PRSP: Poverty Reduction Strategy Paper; U5MR: Under-five Mortality Rate.

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Competing interest:

The views expressed here are those of the authors and do not necessarily represent the views of their affiliated institutions. Also, the authors declare that they have no competing interests.

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Appendix

Table 6. Sample distribution by selected background characteristics in 1991, 1998, and 2004.

Independent variables	1991		1998		2004	
	%	N	%	N	%	N
Household wealth						
Quintile 1 – Poorest	19.59	693	14.16	665	15.01	1,570
Quintile 2 – Poorer	15.77	558	17.48	821	21.71	2,271
Quintile 3 – middle	16.25	575	18.67	877	22.21	2,324
Quintile 4 – Richer	24.56	869	23.61	1,109	21.43	2,242
Quintile 5 – Richest	23.83	843	26.08	1,225	19.64	2,055
Total	**100.0**	**3,538**	**100.0**	**4,697**	**100.0**	**10,462**
Wife's education						
No education	33.0	1,276	24.16	1329	20.09	2,141
Any primary	32.9	1,275	36.21	1992	40.42	4,307
Any secondary/ higher	34.1	1,320	39.63	2180	39.49	4,208
Total	**100.0**	**3,871**	**100.0**	**5,501**	**100.0**	**10,656**
Residence						
Urban	56.47	2,186	49.25	2,709	49.46	5,270
Rural	43.53	1,685	50.75	2,792	50.54	5,386

Total	**100.0**	**3,871**	**100.0**	**5,501**	**100.0**	**10,656**
Regions						
Adamaoua	4.18	162	3.84	211	7.35	783
Centre	25.03	969	21.96	1,208	16.97	1,809
East	4.93	191	6.16	339	6.78	723
Extreme – North	15.40	596	13.25	729	9.75	1,039
Littoral	18.60	720	17.34	954	17.38	1,852
North	7.10	275	8.58	472	8.96	955
Nord – West	6.10	236	9.65	531	8.16	869
West	9.79	379	9.34	514	10.29	1,097
South	2.56	99	2.69	148	7.05	751
South– West	6.30	244	7.18	395	7.30	778
Total	**100.0**	**3,871**	**100.0**	**5,501**	**100.0**	**10,656**