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ON THE DECOMPOSITION AND DYNAMICS OF INEQUALITY OF OPPORTUNITIES: A SPECIAL FOCUS ON EARLY CHILDHOOD HEALTH AND NUTRITION IN TUNISIA

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Abstract

It is widely recognized in the public health literature that health and nutrition during the early childhood period have important long-term and sometimes irreversible consequences on health and wellbeing later in life. In this paper, we attempt to analyze deeply the patterns of inequality of opportunity in health and nutrition outcomes among under-five children in Tunisia. In order to attain such objective, we use several tools, including comparison of the distributions of considered outcomes across a number of circumstances groups; computation of the Human Opportunity Index and estimation of the relative contributions of circumstances using the Shapley decomposition. The main finding reveal reasonable and low levels of inequality in access to all basic healthcare services and nutrition except access to improved water and sanitation. The parents' education, wealth and location of residence are key factors causing such low inequalities. Without more inclusive and pro-poor policy interventions, there are few chances for children belonging in poor families and living in marginalized rural areas to spring out of the poverty lived by their parents.

JEL Classification: D63, D31, O18, O55

Keywords: Child development, Health, Nutrition, inequality of opportunity, Tunisia.

ملخص

من المسلم به على نطاق واسع في أدبيات الصحة العامة أن الصحة والتغذية خلال فترة الطفولة المبكرة لها عواقب هامة وطويلة الأجل، وعواقب لا رجعة فيها أحيانا، على الصحة والرفاه في وقت لاحق من الحياة. في هذه الورقة، نحاول تحليل أنماط عدم المساواة في الفرص الصحية والنتائج التغذوية بين الأطفال دون سن الخامسة في تونس بعمق. ولتحقيق هذا الهدف، نستخدم عدة أدوات، بما في ذلك مقارنة توزيعات النتائج المعتبرة عبر عدد من مجموعة من الظروف؛ وحساب مؤشر الفرص البشرية وتقدير المساهمات النسبية للظروف باستخدام تحلل شابلي. وتكشف النتائج الرئيسية عن مستويات معقولة ومنخفضة من عدم المساواة في الحصول على جميع خدمات الرعاية الصحية الألساسية والتغذية باستثناء الوصول إلى المياه المحسنة والصرف الصحي. ويعتبر تعليم الوالدين وثروتهم ومكان إقامتهم من العوامل الرئيسية التي تؤدي إلى مثل هذه التفاوتات المنخفضة. فبدون تدخلات أكثر شمولا ومناصرة للفقراء، هناك فرص قليلة للأطفال الذين ينتمون إلى أسر فقيرة والذين يعيشون في المناطق الريفية المهمشة لكي ينبثقوا من الفقر الذي يعيشه والديهم.

1. Introduction

It is by now well recognized in the literature that risks to cognitive and physical development are heterogeneously distributed over the life-cycle and are typically higher in earlier stages of life (infancy and early childhood), with substantial long-term and sometimes irreversible effects on later stages of life (youth and adulthood). Risks are awfully high during the ages of 0–5 years, and may have a persistent and negative effect on education, health and labor market outcomes, and thus income-earning potential as adults (World Bank, 2005). Several studies in public health reveal that health and nutrition are crucial at the early age to health and wellbeing later in life. Indeed, sickness and malnutrition during this early period of life may hinder a child's subsequent cognitive and physical development, causing harmful health, productivity and wellbeing outcomes that can endure into adulthood. Any developmental shortages that happen in early childhood may be persistent and permanent (UNESCO 2006).

In developing countries, which Tunisia belongs to, access to basic housing, health and nutrition outcomes are unfairly distributed among children, depending on parental and household characteristics and public health inputs, such as the availability of clean water and sanitation. In this regard, inequality of opportunity can be considered as a main contributor to the observed inequality in child health and nutrition outcomes leading to inequality of opportunity later in life (de Barros, 2009). In Tunisia, children aged less than 14 years represent more than 23.7 percent of the total population; 37.24 percent of them are aged between 0 and 4 years in 2014 (INS, 2014). This is the most vulnerable part of the population, in health care an in social terms. Notwithstanding the gap in access to basic services has been narrowed between rural and urban areas during the last decades, an obvious uneven distribution of basic childhood development outcomes still exist among various regions. While more equitable access to main housing and health services in the early childhood could facilitate human capital accumulation, which in turn could lead to higher economic growth and poverty alleviation (see Galor and Zeira, 1993 for theoretical evidence; Birdsall and Londono 1997 for empirical evidence).

Despite the fact that acceptable level of economic inequality in a society is controversial, policies that afford equal opportunity to all children, not considering of their socioeconomic background, are embraced across the political spectrum (Ersado and Aran, 2014). Early childhood development policies are therefore commonly recognized as some of the few policy areas where the traditional equity-efficiency trade-off does not exist as stated by Heckman and Masterov, (2007). It is thus imperative to comprehend how children's opportunities develop and determine the appropriate policy interventions that contribute to alleviating the impact of predetermined factors. Nationally, further consideration should be accorded to inequality of opportunity in basic services for which child should not be held responsible. Few studies has focused on such inequality among children in Tunisia (see for more details Jemmali & Amara (2015a, 2015b) and Jemmali (2016)).

Giving the growing importance of equality of opportunity in public policy over the last decade, we attempt in the current study to focus on the patterns of inequality of opportunity in child health and nutrition in Tunisia. The data used in the analysis come from the last wave of the Multiple Indicator Cluster Surveys[1] on children and women MICS4 conducted by the National Statistical Institute of Tunisia (NSI) and the UNICEF in 2011/2012. The aim of the paper is twofold: Firstly we analyze the extent of inequality of opportunity in health and nutrition among Tunisian children aged less than 5 years employing the Human opportunity index (HOI) methodology. Secondly, we endeavor, using the Shapley decomposition method,

[1] At these years, no Demographic and Health Survey (DHS) was conducted in Tunisia, for this reason we have opted for using the MICS data in our analysis. MICS is a publicly available dataset. Data can be downloaded for free at the UNICEF's website: http://mics.unicef.org/surveys

to estimate the contribution of circumstances, such as gender, parental education, parental wealth and place of residence, that are beyond the control of those children and affecting their development outcomes. The main questions to answer are: How far Tunisia is from the objective of providing fair and universal access to a set of critical health and nutrition outcomes to all early children regardless of his or her aforementioned circumstances? And is there any improvement in the distribution of considered outcomes during the last decades? To reply to these question, we use concepts and ideas developed in the *World Development Report* (WDR) 2006: *Equity and Development*, WDR 2007: *Development and the Next Generation*, and the methodology developed in the recent and growing literature on assessment of inequality of opportunity (see, for instance Roemer, 1998; de Barros, 2009). As the focus of the study is inequality of opportunity in health and nutrition, the health outcomes are measured by different indicators such as the Z-score for children under age five in Tunisia across the two years. This anthropometric indicator is widely used in child health studies to measure both long-term and short-term malnutrition among children under five. Since malnutrition in this period of life results from both inadequate food intake as well as an inability to absorb or assimilate nutrients owing to disease or infections, the used anthropometric indicator could be a relevant indicator of the child's overall health.

The remainder of the paper is structured as follows: The following section presents a brief literature review of main studies that focus on the inequality of opportunity in health and nutrition outcomes. Section 3 presents the data and empirical methodology used to the measurement and the decomposition of the inequality of opportunities among Tunisian children. Section 4 presents the main results and discussions, while Section 5 concludes the paper with some policy recommendations.

2. Literature Review

The literature on inequality of opportunity is drawn on to highlight the link between the differences in outcomes and differences due to predetermined circumstances over which an individual has no control. Any improvement in the coverage of a basic service may raises equality of opportunity and any improvement in coverage for the lagging groups of children may carries with it further decrease in inequality of opportunities (de Barros, 2009). Such equality of opportunity begin typically with the first few years of a child's life. This critical period of life, in which development in social, cognitive, emotional and other developmental areas are in rapid change and progress, has been described as "*an extended critical period, a window of opportunity for development, closed by age three*" (UNESCO 2006, p. 109). Moreover, during this early period, children are particularly sensitive to the conditions in which they live without having a control over them. For instance, poverty, lack of healthcare providers, malnutrition are issues that harm its development is quite fragile in the face of issues like poor nutrition. For instance, being born to a poor family that couldn't afford necessary nutrition and healthcare or living in an underserved geographic location, are entirely beyond the child's control, but harms its development and determines its opportunities to accumulate crucial health assets.

Several studies have attempted to examine the patterns of inequality of opportunity on early childhood development in a number of countries. Drawing on the household income and expenditure survey data from South Africa, Zere and McIntyre (2003) analyzed the correlation between socioeconomic status and malnutrition among children aged less than 5 years. As expected, they found that stunting and wasting were most highly concentrated in the poorest and unprivileged regions of the country. The study found, then, that children living in poor family and poorest regions are more exposed to such diseases. One other finding of the study is the racial inequality: among the white population, no significant inequities were found, while nonwhite children from metropolitan regions showed the highest

levels of stunting in the country. In the same line, Burgard (2002) assessed inequality of opportunities taking into account the racial inequalities in child stunting in Brazil and South Africa. The author found that racial differences and household socioeconomic status are strongly linked with stunting. Monteiro et al. (2010) focused, in a similar study undertaken in Brazil, on the relationship between the prevalence of child malnutrition in relation and income and basic services redistribution policies. The main finding of the study is that over the 33 years examined, the gap in terms of stunting between children from poor and rich households had shrinked considerably along with decline of income inequality, a rise in purchasing power, and increase in access to healthcare and other basic services in unprivileged regions.

Using different inequality of opportunity indices, Singh (2011) measured inequalities in malnutrition and immunization for children in India, and finds significant regional disparities. In order to evaluate the trends for malnutrition among the early aged children, Pathak and Singh (2011) have used in another study, bivariate analysis, poor-rich ratio and concentration indices. Mohanty and Pathak (2009) used the same methodological approach to assess the inequalities in access to maternal care services and child immunization. The common finding of these two studies, dealing with the Indian context, is the significant disparities in health and nutrition outcomes between the poor and rich. Limwattananon et al. (2010) in Thailand and Axelson et al. (2012) in Vietnam used the same concentration indices to investigate disparities in maternal health and early child health outcomes. Both studies found significant inequalities between poor and non-poor households. Employing the multivariate logistic regression, Anwar et al. (2008) examined inequities in the use of maternal healthcare services in Bangladesh. The authors found significant inequalities due to asset ownership, area of residence, and parental education.

There have been a few studies focusing on inequality of opportunity in health and nutrition in Arab countries. The majority of these studies are dealing with the extent of inequality in health in Egypt. Compared to 54 countries, Egypt was found as one of the least inequitable countries in terms of skilled birth attendant and measles immunization (Barros et al., 2012); it ranks 50th in the considered sample. While Wagstaff (2003), drawing on the 1995/6 Egypt DHS, stated that Egypt has high concentration indices (i.e., high inequality) in under-five mortality rate and infant mortality rate compared to other countries. Another study on Egypt by Boutayeb and Helmert (2011) examined inequities in maternal care between rich and poor women, as well as inequities between women living in urban and rural regions. Recently, Ersado and Aran (2014), in their study on inequality of opportunity in Egypt during the 2000, found that Egypt has made considerable progress in the availability of and access to different basic services (Water and Sanitation, Education, Health, Nutrition) for children and mothers, in some cases with an overall pro-poor effect. An appreciable improvements, translated by a decline in inequality of opportunity over the past decade, have been made in healthcare utilization in the country before and during pregnancy and immunizations. The study reveals also that Family background, especially parents' education and wealth, and geographic factors are the key factors affecting child development outcomes in Egypt.

In a recent study, Assaad et al. (2012) analyzed the extend of inequality of opportunity in child health outcomes in Egypt and some Arab countries and Turkey using a number of Demographic and Health Survey (DHS) data. They employed indicators for stunting and wasting standardized by height and weight of children as outcome variables, instead of the standard Z-scores computed by comparing the observed anthropometric measures to reference distributions of height and weight for healthy children of the same age and sex. They found mainly that total inequality in Egypt is increasing over time and geography is the

main prevalent circumstance influencing height and weight of children, followed by demographic and educational parents' characteristics.

Notwithstanding a number of studies have been undertaken to examine inequality of opportunities in Tunisia such as Jemmali and Amara (2015a, 2015b) and Jemmali (2016), no study, in our knowledge, hasn't focused on health and nutrition issues. The common finding of the three previous studies is the large and significant disparities, particularly in access to sanitation facilities and secondary education between the East (Littoral) and Western (Inland) areas. Area of Location, parent's socioeconomic and educational characteristics are found as the most important circumstances contributing to such regional disparities. To estimate the contribution of different circumstances in the inequality of opportunity, authors in the first two studies used the variance decomposition analysis employed previously by Son (2013). While in the third study, Jemmali (2016) used the Shapley decomposition method similarly to Ersado and Aran (2014) and Hassine and Zeufack (2015).

The current study differs from the aforementioned studies in terms of outcomes variables. It shed more light on inequality of opportunity in health and nutrition using a number of outcomes and a set of circumstances that are presented in more details in the following section. To the best of our knowledge, this is the first paper providing a detailed analysis of inequality of opportunity in health and nutrition for Tunisia.

3. Data and Methodology

3.1 Data

We use data from the fourth round of the Multiple Indicator Cluster Surveys (MICS4 Tunisia) conducted in 2011-2012 by the Ministry of Development and international cooperation in collaboration with the National Institute of Statistics. Financial and technical support was provided by the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA) and the Swiss Cooperation Office in Tunisia. The Multiple Indicator Survey is a household survey program developed by the UNICEF in the mid 1990s in order to assist countries in filling data gaps for children and women. Using key indicators (such as children nutritional status, women fertility history, water and sanitation, HIV and AIDS, characteristics of household, and so on), the MICS survey enables countries, more specifically the middle income ones, to achieve the Millennium Development Goals (MDGs), the goals of a World Fit for Children (WFFC) and other nationally and internationally agreed commitments.[2]

As with MICS2 in 2000-2001 with 29645 households and MICS3 in 2005-2006 with 9600 households, the current round of MICS (MICS4 Tunisia survey) highlights significant progress made over the past five years, particularly in terms of health, education and child protection, as well as in women's health. The fourth round of Tunisian's MICS were collected from a sample size of 9600 households, representative at the national level, for both urban and rural areas and at the level of nine regions of the country (Greater Tunis, North East, North West, Middle East, Governorate of Kairouan, Governorate of Sidi Bouzid, Governorate of Kasserine, South East and South West).

A stratified two-stage random sampling approach was used for the selection of the 9600 households. At the first stage of selection, 480 clusters (census enumeration areas) are randomly selected (with probability proportional to size (PPS)) among all clusters of the General Census of Population 2004. At the second stage of selection, 20 households are selected within each of the 480 clusters, to get a total sample size of 9600 households. Among the 9600 households selected for the sample, 9329 were identified at the time of the

[2] For more information on the MICS surveys, please visit www.childinfo.org.

survey, and a total number of 9171 were successfully interviewed, resulting in a response rate of 98%. From the surveyed households, 10514 women aged 15-49 years were identified and 10215 of these were successfully interviewed, yielding a response rate of 97% within interviewed households (Table 1).

3.2 Outcome variables

A total of 11 indicators have been selected from the MISCs surveys and grouped in two outcome categories: *(i)* access to basic healthcare during pregnancy and birth and early postnatal periods and *(ii)* nutrition that includes indicators on malnutrition and micronutrient intake. Three composite indexes are developed afterward using the set of these indicators. Under the first set of outcomes, the subsequent variables, quite similar to variables used by Ersado and Aran (2014), are involved in the analysis: *(i)* lack of antenatal care (approximated by the occurrence of mother not having any blood tests during pregnancy[3]); *(ii)* birth not taking place at health facilities; *(iii)* birth not being attended by skilled health professional; *(iv)* child not having a postnatal check-up (within two months after birth); *(v)* health examination and regular immunizations within one year after birth; *(vi)* access to safe water and *(vii)* access to toilet (a health shield)[4]. The second category of outcomes is associated to levels and trends in malnutrition and micronutrient intake and access to clean water (a nutritional must) in the early years. To investigate the disparities in malnutrition levels across various circumstance groups, common anthropometric measures (Z scores[5]) such as *(i)* stunting[6] (height-for-age) , *(ii)* wasting[7] (weight-for-height), and *(iii)* underweight[8] (weight-for-age) are used to estimate the nutritional status of child (see Assad et al. (2012) and O'Donnell & Wagstaff, (2008) for more details about these measures). There is significant evidence that malnourishment, particularly in childhood, raises the risk of death, inhibits cognitive development, and can result in a higher disease risk later in life (O'Donnell et al. 2008). In this regard, it's also notable that children have the necessary level of micronutrient intake for healthy development. Access to iodized salt, iron tables during pregnancy and Vitamin A in early infancy are broadly used indicators for micronutrient intake. Giving that such indicators aren't available in the MICS 4 survey, we use in the current paper one variable that is important for determining and supplementing iron deficiency anemia during pregnancy: *(v)* whether the mother has had blood tests during her pregnancy.

The two tables 2a and 2b illustrated respectively the basic descriptive statistics of health and nutrition outcomes across the country and the different regions (Grand Tunis, North East,

[3] A healthy pregnant woman has a blood test to rule out the possibility that her baby has certain abnormalities, such as Down's syndrome.

[4] See de de Barro (2009)

[5] Z-scores are calculated by mean of the CSPro software using the WHO international reference population; As recommended by WHO, exact age (not completed months) are used to calculate these Z-scores.

[6] Height-for-age (H/A) reflects cumulative linear growth. Height for age deficits indicate past or chronic inadequacies of nutrition and/or chronic or frequent illness, but cannot measure short-term changes in malnutrition. Low H/A relative to a child of the same sex and age in the reference population is referred to as "shortness." Extreme cases of low H/A, in which shortness is interpreted as pathological, are referred to as "stunting." H/A is used primarily as a population indicator rather than for individual growth monitoring (O'Donnell & Wagstaff, 2008).

[7] Weight-for-height (W/H) measures body weight relative to height and has the advantage of not requiring age data. Normally, W/H is used as an indicator of current nutritional status and can be useful for screening children at risk and for measuring short-term changes in nutritional status. At the other end of the spectrum, W/H can also be used to construct indicators of obesity. Low W/H relative to a child of the same sex and age in a reference population is referred to as "thinness." Extreme cases of low W/H are commonly referred to as "wasting." Wasting may be the consequence of starvation or severe disease (in particular, diarrhea) (O'Donnell & Wagstaff, 2008).

[8] Weight-for-age (W/A) reflects body mass relative to age. W/A is, in effect, a composite measure of height-for-age and weight-for-height, the term "underweight" is commonly used to refer to severe or pathological deficits in W/A. W/A is commonly used for monitoring growth and to assess changes in the magnitude of malnutrition over time. However, W/A confounds the effects of short- and long-term health and nutrition problems (O'Donnell & Wagstaff, 2008).

North West, Centre East, Kasserine, Kairouan, Sidi Bouzid, South East and South West). While the first columns table show high and equitable access to health outcomes among the nine regions, a remarkable disparity in access to water and sanitation facilities is observed in the last two columns of the table ranging respectively between 36.48% and 18.03% in Sidi Bouzid, the most lagging region in the country and 69.77% and 84.88% in the metropolitan region. In the same line, the table 3b reveals that no significant disparity in nutritional status is shown across the different regions. Behind this equitable distribution of both health and nutrition outcomes, access to these basic services may differ more significantly across various population sub-groups.

3.3 Circumstances variables

On the other side, nine circumstance variables, that determine early child's opportunity access to health and nutrition outcomes, are involved in the analysis. Taking into account these circumstances, given below, population of children surveyed is divided in several subgroups. From these various subgroups, we focus later in the analysis on two specific and extreme groups, least and most advantaged group, in order to highlight the role of such circumstances in determining access of child to the considered outcomes. The nine circumstance variables used in the current application are:

- Region: Grand Tunis (metropolitan region), North East, North West, Centre East, Kasserine, Kairouan, Sidi Bouzid, South East and South West, (9 categories).
- Location: Urban and rural areas, (2 categories).
- Number of children aged under 5 years, (Discrete variable).
- Household composition: number of members in the household, (Discrete variable)
- Age of household head: in year, (Continuous variable).
- Gender of Household head: 0 if female and 1 if male, (2 categories).
- Father's Education: None formal education, Primary/Lower secondary, Secondary, University (6 categories).
- Mother's Education: None formal education, Primary/Lower secondary, Secondary, University, (6 categories).
- Economic wellbeing of household: Quintile of economic wellbeing (5 categories).
- Gender of the child: 0 if female and 1 if male, (2 categories).

These circumstances could be grouped into four dimensions: *(i)* child characteristics (e.g., gender of the child); *(ii)* demographic characteristics of the household (e.g., number of siblings aged under 5 years and household composition); *(iii)* geographical location of the household (e.g., Urban/rural status and region of residence); *(iv)* socio-economic characteristics of the father and mother (e.g., educational level of both father and mother, age and gender of the household head and household's wealth quintile). Table 3 gives a summary of the main descriptive statistics of some circumstances variables across different regions for the year 2011/12.

3.4 Empirical methodology

As noted above, we aim in the current study to estimate and decompose the common and synthetic measure of the inequality of opportunity, the HOI. The index was firstly developed in 2006 and included to the report of the World Bank, (2006). The first application of this novel index was developed in Latin America and the Caribbean (LAC) by De Barro et al, (2009). The main purpose of using such index is to assess the extent to which individual and household's circumstances (such as birthplace, wealth, gender,...) influence an early child's probability of accessing basic services required to have a good health and nutrition. It's noteworthy that we focus mainly in the current study on inequality of opportunity among

early children for two main reasons. Firstly, unlike adults and other ranges of age, children aged less than 5 years haven't the capacity to access to basic health and nutrition outcomes by themselves. Accordingly, access to these services is considered during the early childhood as an opportunity which depends strongly on the family's circumstances and other factors. The selection of this range of age is explained as well by the fact that required interventions and policies aiming the alleviation of inequality between subgroups early in the life-cycle (children) of an individual are obviously more cost effective and relevant than interventions done later in life.

As noted above, the HOI combines measurements of both the absolute level of opportunities coverage and how fairly those opportunities are distributed among the different circumstances groups. The first component of the index is the average coverage rate of access to specific opportunity, while the second component measure the fairness of distribution of this opportunity.[9] Following de Barros (2009), Son (2013), Jemmali and Amara (2015a, 2015b), and Jemmali (2016) and given the surveyed random samples of the population, a binary variable z_i is defined taking a value of 1 if the i^{th} child has access to the health or nutrition opportunity and takes a value of 0 if he lacks access to this opportunity. It can be easily demonstrated that $E(z_i) = p_i = P(z_i)$, where p_i is the probability that the i^{th} child has access to a specific opportunity. Such probability depends on a range of exogenous (explicative) variables linking to individual, household, and geographical characteristics outside the child's control (circumstances), such as: gender, parental education, household wealth, geographic location and others. Before calculating the final index, circumstance groups are defined as a set of children sharing a common set of features. For instance, male children having 2 siblings and living in urban areas in the metropolitan region, with higher educated and wealthy parents; on the other side we find a group that contains female children having 4 siblings and living with no educated and poor parents in rural areas in Sidi Bouzid.

Giving a set of predefined k circumstance variables $x_{i1}, x_{i2}, \dots, x_{ik}$, the probability p_i for each child can be estimated by means of a simple *logit* model as follows:

$$p_i = \frac{e^{(\beta_0 + \sum_{j=1}^{k} \beta_j x_{ij})}}{1 + e^{(\beta_0 + \sum_{j=1}^{k} \beta_j x_{ij})}} \quad (1)$$

The vector of parameters β_j of the logit model can be estimated using the maximum likelihood method. The obtained maximum likelihood estimate, $\hat{p}_i$, provides an accurate estimate of the probability of access to the specific opportunity depending on circumstance variables defined above. Then, any gap in estimated probabilities between circumstances-groups is due to the existence of an inequality of opportunity among children belonging to such groups. After estimating the probability of access to opportunity for each group, a Dissimilarity index that gives a measure of the dissimilarity of access rates to a given service, is computed as follows (World Bank, 2006):

$$\widehat{D} = \frac{1}{2\bar{p}} \sum_{i=1}^{n} w_i |\hat{p}_i - \bar{p}| \quad (2)$$

Where $\widehat{D}$ is the estimated relative mean deviation, w_i is the population weight associated to the specific opportunity and $\bar{p}$, called level of coverage, is the average prevalence of access to the service in the surveyed sample, computed using the following formula:

[9] The current section merely gives the basic conceptual method for computing the Human Opportunities Index as explained in the recent literature. For further details and discussion, refer to De Barros (2009) which gives a more exhaustive explanation of the procedure of computing the two components of the HOI: the coverage rate and the Dissimilarity index (D-index). The methodology employed in the current exercise to calculate the HOI follows similar notations used in the recent literature.

$$\bar{p} = \sum_{i=1}^{n} w_i \hat{p}_i \quad (3)$$

The weight w_i is equal to $1/n$ where n is the size of the selected sample.

The D-index is used to measure the level of inequality of opportunity explained by the different circumstances, while *E* which is equal to the difference $(1 - D)$ is the measure of the equity of opportunity. As defined above, the value of *D* is ranging between 0 and 1 (0 to 100 in percentage terms). $D = 0$ means that each child in the population benefits from the same opportunities, while $D = 1$ means that merely one individual in the society benefits from all opportunities.

After estimating the two components: average access to opportunities ($\bar{p}$) and D-index (*D*), the HOI is calculated as the product of $\bar{p}$ and *D-index* (see Eq. 4):

$$HOI = \bar{p}(1 - D) \quad (4)$$

Giving that *D-index* is ranging between 0 and 1, HOI is necessarily less than or equal to the level of coverage ($\bar{p}$). This implies that a the HOI, which can be identified as an inequality-adjusted coverage rate, decrease when the associated *D-index* is more close to 1. Accordingly, each policy or intervention could increase the value of HOI by means of improving the total opportunity coverage ($\uparrow \bar{p}$), boosting equity of opportunity ($\downarrow D$) or both coverage and equity.

After estimating the level of equality of opportunity proxied by the HOI, it is promising to assess the contributions of different circumstantial variables in such equality of opportunity using the decomposition procedure proposed by Shorrocks (2013).[10] This decomposition method, called *Shapley decomposition*, allow us to assess the marginal contribution of each circumstance (such as gender, education, location, family features) to inequality in access to basic health and nutrition services. It consists of estimating the marginal effect in the HOI of each inequality contributor (circumstance) in a specified sequence of elimination (Betti, 2008; Shorrocks, 2013). The same procedure is applied to all considered outcomes in order to estimate the relative contributions of different groups of circumstance to the observed variance of different outcomes.

Following de Barros (2009), we assume that the dissimilarity index (and therefore the HOI) depends on a set of circumstances and adding other circumstances usually raises the value of the *D-index*. In other words, the impact of adding a circumstance *A* is given by the following formula:

$$D_A = \sum_{S \subseteq N \setminus \{A\}} \frac{|s|!(n-|s|-1)!}{n!} [D(S \cup \{A\}) - D(S)] \quad (5)$$

Where *N* is the set of all the *n* circumstances; and *S* is the subset of *N* circumstances obtained after omitting the circumstance *A* (i.e. *S* does not contain the circumstance *A*). $D(S)$ is the dissimilarity index estimated with the set of circumstances *S* (after omitting the circumstance *A*) and $D(S \cup \{A\})$ is the estimated dissimilarity index considering the set of circumstances *S* and the circumstance *A*. Then, using the shapely procedure, the contribution of the omitted circumstance *A* to the dissimilarity index can be estimated using the following formula:

$$\mathrm{M_A} = \frac{D_A}{D(N)}$$

Where $\sum_{i \in N} M_i = 1$. This is a critical property satisfied by the Shapley decomposition, which means that the sum of contributions of all circumstances should add up to 1 (100%). To estimate the marginal effect of each contributor, among the nine circumstances, on

[10] This method of decomposition is based mainly on the concept of Shapley value in cooperative games

inequality of access to health and nutrition opportunity, the above procedure is applied afterward.

4. Empirical Analysis

4.1 Circumstances and access to basic healthcare and nutrition

Before delving into analyzing the extent and the main drivers of inequality of health and nutritional opportunity among early children in Tunisia, a descriptive analysis of how some demographic, socioeconomic and geographical circumstances, which are naturally beyond the children´s control, affect these inequalities, is conducted afterward. Instead of considering each outcome alone, a new variable is created that take the value 1 if the child, respectively benefits from access to all healthcare services and is well protected from malnutrition risks and 0 if not. To emphasize the impact of some principal circumstances, including the location of residence, the wellbeing and parent's education on the distribution of outcomes, we divide the population into two main and opposite groups: least advantaged group and most advantaged one.[11]

4.1.1 Access to basic healthcare services

Figure 1 illustrates the gap between the two extreme groups (least and most advantaged) in access to basic healthcare services before and after birth (Health_1) and access to necessary immunizations (Health_2) as well as access to housing services: water and sanitation facilities (Health_3). It's noteworthy that the aim of considering solely the two extreme groups is to highlight the disparity that could occur between children in access to health and nutrition outcomes. It appeared from the figure that children from the two groups benefit from considerable access to basic healthcare before and after birth including the necessary immunizations; more than 92.5% of the total number of children in each group have access to aforementioned services. The figure shows as well that the gap between the two extreme groups is narrow in access to these services. This preliminary result lead us to conclude that the government have played a great role, during the last decade, in providing these basic healthcare services to all population independently of the geographical and socioeconomic circumstances that children haven't no effect on. Nonetheless, only 51.47% of the total children living in better conditions and 0.52% living in difficult conditions have access to basic housing service (water and sanitation facilities), while these necessary services help improve hygiene and health standards. When comparing the two percentages of coverage of the two groups, it's easy to find a large gap in access to water and sanitation between the least and most advantaged groups. This is due to the huge disparity in access to basic sanitation facilities between different groups particularly between rural and urban areas (see Table 3).

4.1.2 Access to basic nutrition services

Similarly to healthcare services, the propensity of not having a malnutrition problem during the five years after birth differs a bit between children belonging to the two extreme groups. The figure 1 reveals that the gap is about 10.64 point for the first composite index (Nutrition_1[12]), and 1.65 point for the second one (Nutrition_2[13]). It appeared from this

[11] Most and least advantaged groups of early children are defined depending on some circumstances variables. These two population groups make up both the two extremes of the set of groups constructed based on circumstances; they account for nearly 18.5% of the total number of early children aged between 0 and 5 years. The least advantaged group, as presented in the last columns contains children from rural areas, with poor parents having no formal education and having more than 2 children aged less than 5 years. On the other side, the most advantaged group contains children who are from urban area, living with wealthy parents having higher education level and a having a number of siblings less than 2 children.

[12] The composite index, Nutrition_1, is constructed by assuming that a child who haven't a malnutrition problem should be neither stunted, nor wasted, either underweight.

[13] The second nutrition indicator, Nutrition_2, is the defined simply by the access of the mother to blood tests during the pregnancy period.

comparison that living in urban areas with more wealthy and educated parents have played a considerable role in avoiding any malnutrition risk, while living in rural areas with poor and less educated parents may increase the propensity of having at least one aspect of malnutrition such as stunting, wasting or underweight. As noted above, no significant disparity in the propensity of having the required blood tests, which means that the government has succeeded in providing this service to the majority of mothers during their pregnancy independently of the household background variables. After this brief descriptive analysis of health and nutrition outcomes, we turn in the following sub-section to more deeply investigation of the inequality of opportunity in the two sectors with a special focus on the main drivers that shape the inequality pattern in health and nutrition facilities.

4.2 Inequality of opportunity in access to healthcare facilities and basic nutrition

4.2.1 Inequality of opportunity in access to basic healthcare

Figure 2 reveals the estimated coverage, Dissimilarity index and the different HOI levels of all basic healthcare services including some composites indicator such as the index of Healthcare before and after birth and access (HEA1) and the housing component (HEA3). A child or mother (before birth) is assigned the value of 1 for the index HEA1 if all the antenatal and postnatal healthcare are undertaken during the pregnancy and the first two years of child's life. Similarly, a child is assigned the value 1 if he benefits from access to both safe water and sewage facilities (HEA3). The Figure 2 shows at the national scale greater level of both coverage and equality index (1-D-index), and accordingly higher level of HOI index. This high level of equality of opportunity, above 90%, indicates that a the majority of children, in Tunisia, benefit from all healthcare services regardless of their circumstances living and region of residence.

Nonetheless, Regular access to improved drinkable water and sanitation services, which is a main condition to ensure basic health care and hygiene to population, shows a lower level of HOI, particularly in access to sanitation. In fact, only 34.22 percent of access to sanitation services is distributed equitably, and when considering the composite index HEA3 the level of the HOI decrease to the lower value, 22.52 percent (see Fig. 2). This leads us to mention that inequalities in access to improved drinking water and sanitation facilities still persist around the country. Giving that these basic housing services and hygiene[14] are essential ingredients to ensure child health and survival, development and growth, government should improve access to clean drinking water and effective sanitation more specifically in unprivileged and marginalized rural areas (see previous section). To highlight the main causes of such inequality in housing services, a Shapley decomposition is conducted afterward.

The Shapley decomposition results presented in the Figure 3 reveal that regional variables that are urban/rural status and region added to the household's welfare explain all the largest part of the variations in access to immunizations and housing facilities. It appeared from the figure that these geographical and economic variables explain more than 84 percent of the total variation of the composite housing index (HEA3). The decomposition results reveals, as well, that parent's education and urban/rural status appear to be the main factors in determining whether the child has benefit from a professional assistance in birth and a postnatal checkup.

4.2.1 Inequality of nutritional opportunity

As noted above, three main malnutrition indicators, a composite index (NUT1) constructed from these indicators and access to blood tests during pregnancy are used in the current study

[14] To ensure hygiene, access to water for cleansing and hand washing at critical times is essential particularly for children.

to assess inequality of nutritional opportunity. The first three variables are linked directly to the nutritional status of the Child, while the second is associated indirectly with such nutritional status. It appears from the Figure 4 that malnutrition indicators such as stunting, wasting and underweight prevalence have deteriorated significantly in Tunisia, inequality of opportunity for these indicators, measured by the D-index is very low, suggesting no significant disparity among circumstance groups. Unsurprisingly, the HOI for all the nutrition indicators are high and close to the coverage value.

The decomposition of the variability in anthropometric measures and access to blood test, illustrated in the Figure 5, explained by circumstances shows that geographical and economic circumstances added to parent's education explain a large percentage of their variance. Therefore the malnutrition and non access to blood tests during pregnancy is a real problem for Tunisian children who belong to poor household living in unprivileged rural areas despite the low prevalence of malnutrition issues and the less inequality in nutritional opportunity in the country. The Shapley decomposition of inequality of opportunity in malnutrition indicators further shows that females are not more likely to be stunted, wasted or underweight than males like other developing countries such as Egypt (Ersado and Arab, 2014).

5. Concluding Remarks and Policy Implications

Fairness, equity, and social justice in the distribution of different outcomes are no longer in the camp of philosophers and theorists; rather, they become recently in the realm of policy design and economic reform. Increased private participation in providing some basic health services does not exempt governments from their primary responsibility to ensure children's access to basic healthcare and hygiene services such as assistance in birth, antenatal and postnatal care, immunizations, safe drinkable water and sanitation. Equal access to these services and others, regardless of geographical, socioeconomic, demographical circumstances that are beyond the control of children is a crucial and necessary step towards justice and fairness in the society. In this respect, the current study is focusing on the determination of the level in equity of the distribution of health and nutritional opportunities among Tunisian children. Drawing on the last wave of the MICS surveys, the MICS4, the analysis was carried out mainly using the Human Opportunity Index (HOI) methodology initially developed by the World Bank. From the perspective of policy makers, such methodology may provide a practical diagnostic tool for policy analysis and an appropriate point of reference for gauging progress in the equality of opportunity thanks to its flexibility for application to various circumstances, opportunities, and population groups. Furthermore estimating the contribution of each circumstance, using the Shapley decomposition method, is a crucial step to analyze binding constraints and afford equitable opportunities to all Tunisian children across different subpopulation groups.

The main findings of the study reveal that Tunisia has experienced, during the recent decades, a significant progress with regards to the availability and access to basic healthcare services and ensuring a good nutrition for early children, in some cases with a pro-poor overall effect. In particular, significant improvements have been made in access to immunizations and antenatal and postnatal care. Accordingly, less inequality of opportunity in access to these basic services is observed despite the low coverage rate of these services in some rural inland areas. In these lagging regions, there are areas of persistent and emerging concerns that require urgent interventions, such as access to improved water and sanitation facilities. Geographical circumstances such as urban/rural and region of residence and educational and economic characteristics of households have played the main role in the inequality of health and nutritional opportunities.

Such main findings lead us to note that targeted interventions and more appropriate investments in favor of the less advantaged regions in rural areas and poor population may

afford the significant potential for improving the overall equity in health conditions and nutrition status among children. In this respect a more inclusive approach and special efforts would be needed for those early children exposed naturally to various risk factors. From a policy perspective, evidence indicates that appropriate interventions and policies to maintain equality of opportunity between different children groups early in the lifecycle of an individual are noticeably more cost effective and successful than any interventions later in life.

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Figure 1: Access to Basic Healthcare and Nutrition by Groups (2011/12)

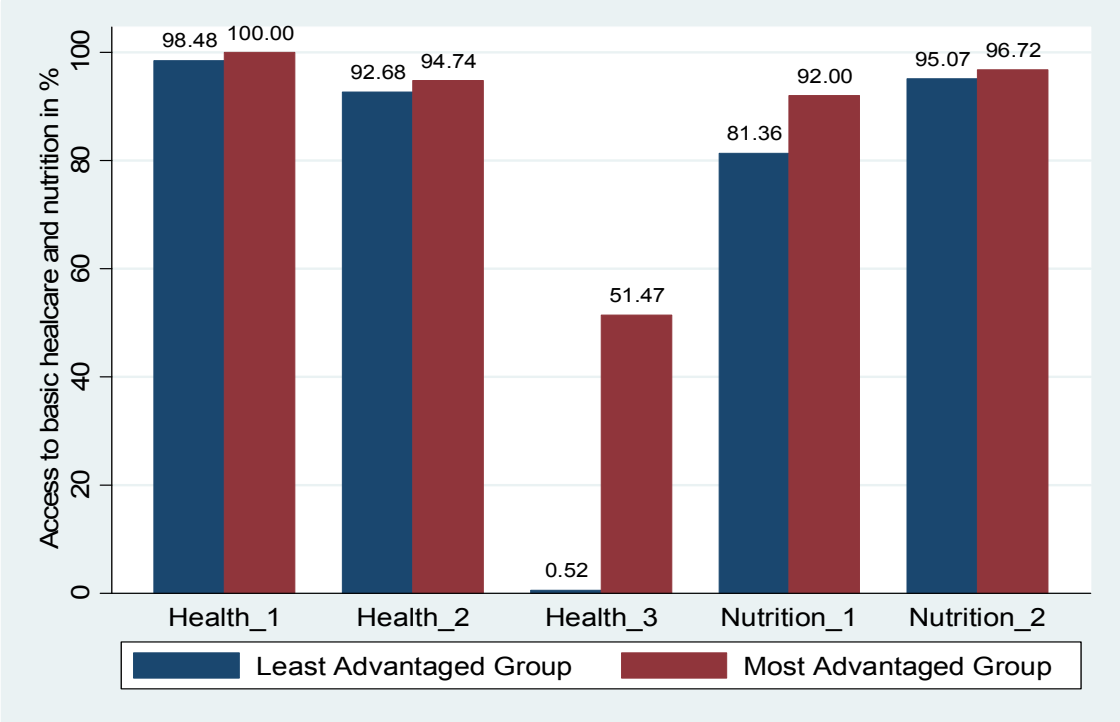

Figure 2: Inequality of Opportunity in Access to Healthcare Services

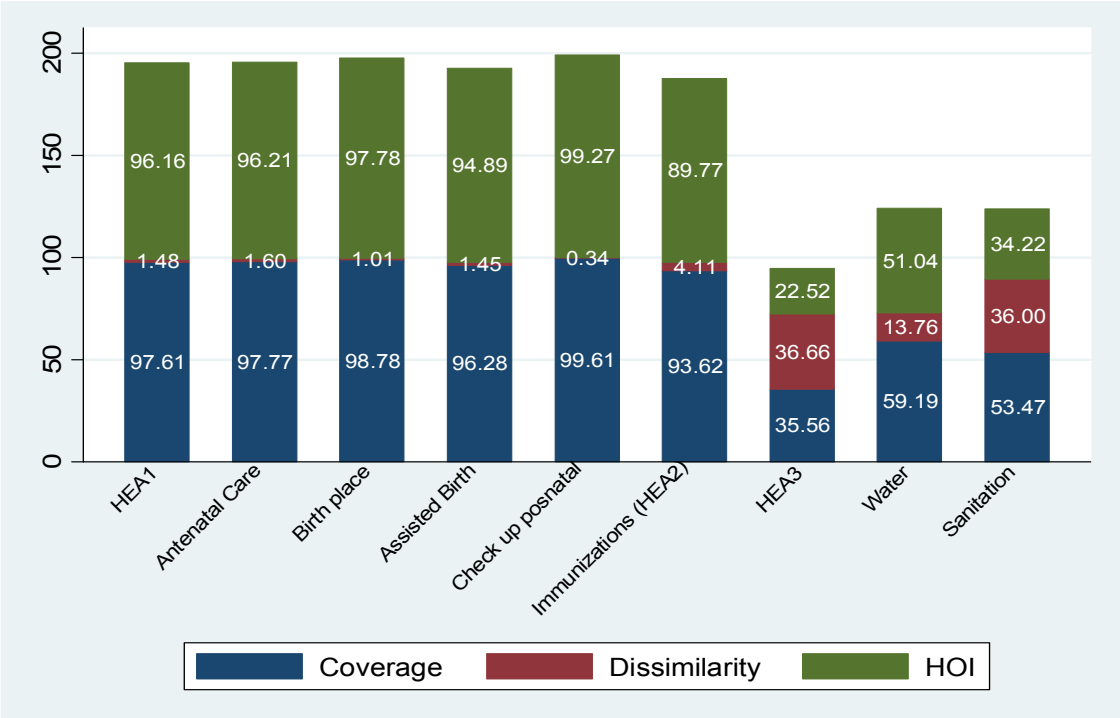

Figure 3: Shapley Decomposition of Healthcare Opportunities

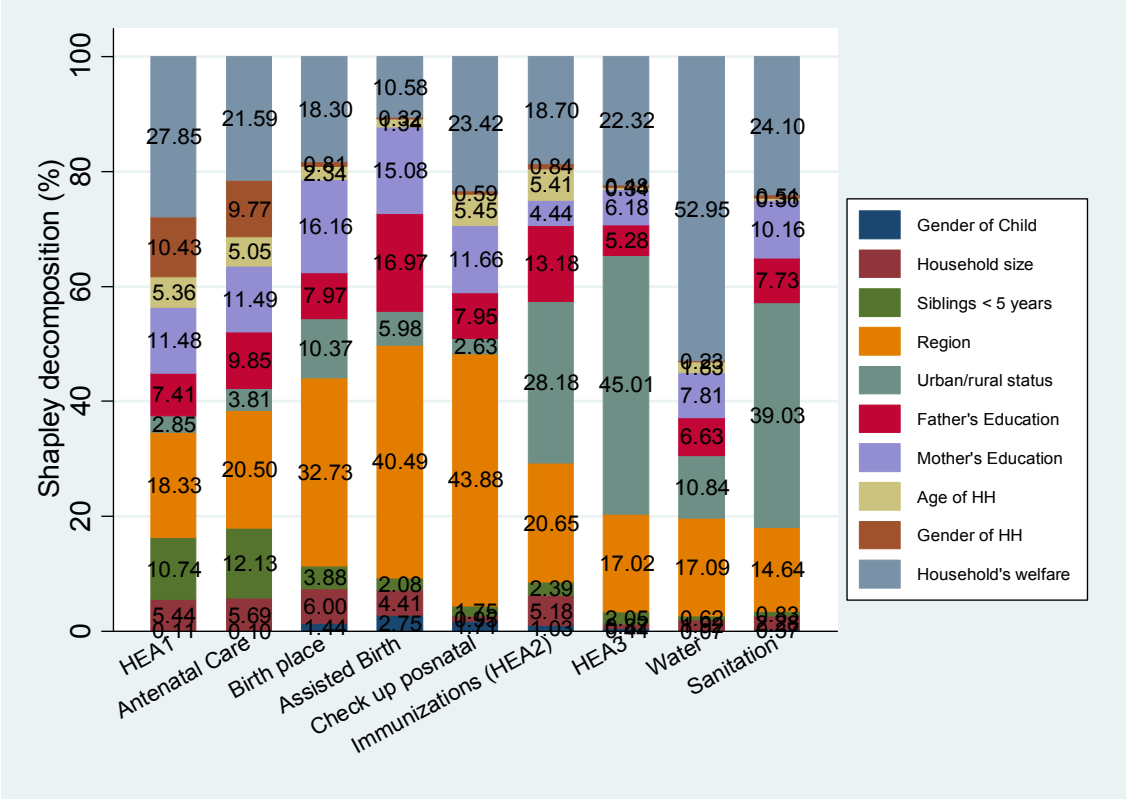

Figure 4: Inequality of Opportunity in Access to Nutrition

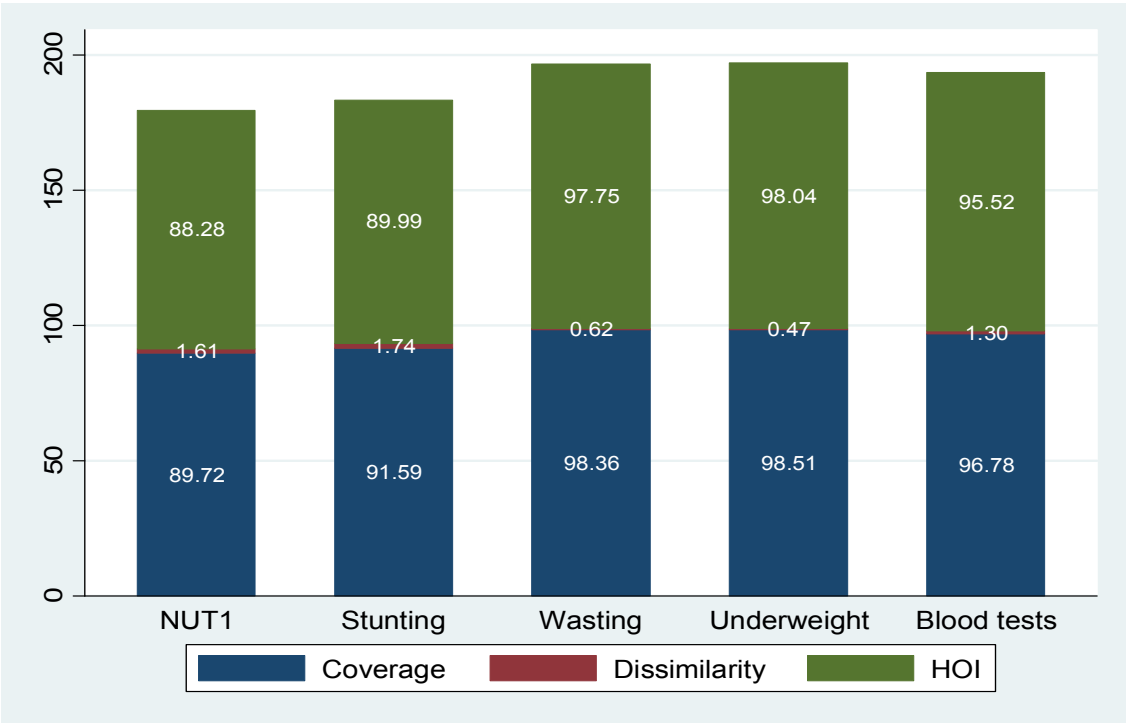

Figure 5: Shapley Decomposition of Nutritional Opportunities

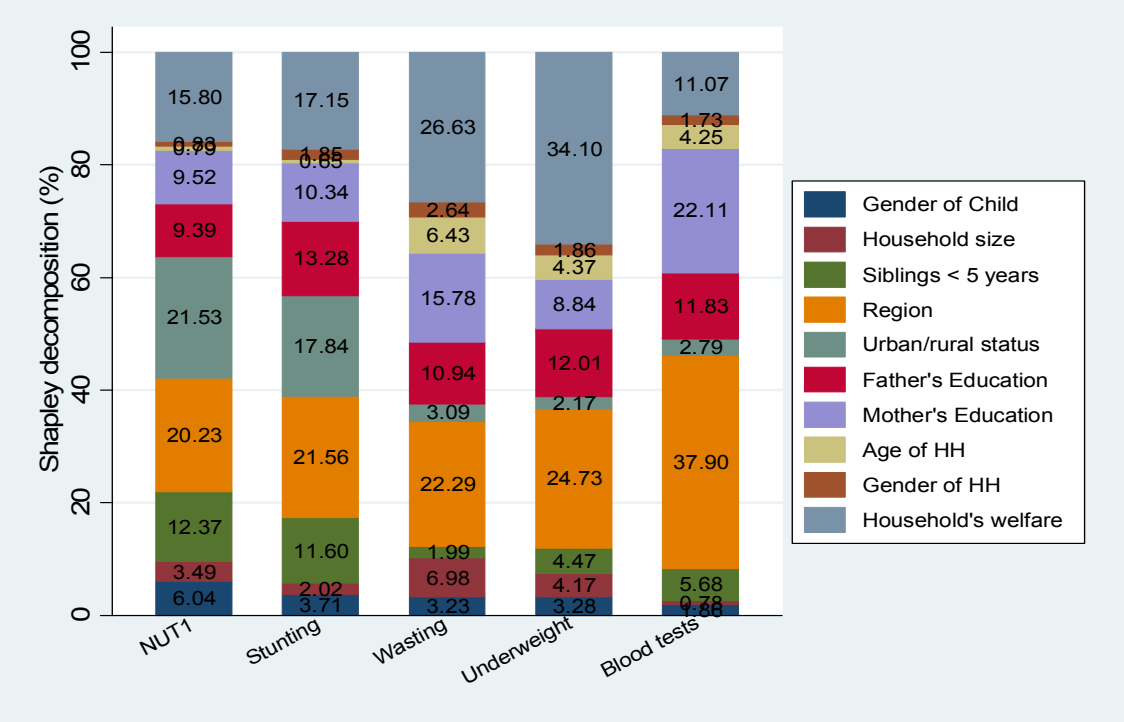

Table 1: Number of Clusters, Number of Households and Number of Women Aged 15-49 Years by Region

Region	# clusters	# households surveyed	# households interviewed	# women (15-49 years) surveyed	# women (15-49 years) Interviewed
Grand Tunis	70	1400	1356	1507	1455
North East	60	1200	1160	1251	1220
North West	60	1200	1133	1135	1101
Middle East	60	1200	1074	1093	1018
Kairouan	45	900	875	1004	995
Sidi Bouzid	40	800	790	980	967
Kasserine	45	900	845	989	957
South East	50	1000	974	1251	1234
South West	50	1000	964	1304	1268
Tunisia	**480**	**9600**	**9171**	**10514**	**10215**

Source: MICS4 Tunisia, Final report (French version), UNICEF-Tunis.

Table 2a: Descriptive Statistics of Health Outcome Variables (By Region) (2011/12)

Region	Antenatal care	Birth's place	Birth attended by Professionals	Postnatal check	Immunization	Access to water	Access to sanitation
Grand Tunis	97.10	100	97.87	100	78.85	69.77	84.88
North East	97.35	100	97.42	100	78.72	59.63	45.72
North West	99.04	98.08	95.33	98.04	88.24	63.08	45.16
Centre East	99.12	100	98.26	100	86.84	60.34	66.78
Kasserine	97.12	100	96.3	99.04	85.11	63.35	24.91
Kairouan	98.45	93.80	90.98	98.35	83.78	44.15	27.42
Sidi Bouzid	89.80	89.69	84.47	98.85	72.34	36.48	18.03
South East	100	98.57	97.20	100	85.29	39.94	32.54
South West	100	96.19	90.99	99.01	100[15]	64.52	49.60
Tunisia	97.69	97.59	94.62	99.34	82.60	55.92	44.97

Note: The Table reports the percentage of the reference category

Table 2b: Descriptive Statistics of Nutrition Outcome Variables (By Region) (2011/12)

Region	Blood tests	Stunting	Wasting	Underweight
Grand Tunis	98.51	93.36	97.05	99.26
North East	95.92	89.59	98.74	99.37
North West	97.09	88.66	99.58	98.32
Centre East	94.64	94.05	98.41	98.81
Kasserine	95.05	87.60	98.06	98.06
Kairouan	98.43	85.82	98.88	97.01
Sidi Bouzid	93.18	85.71	98.62	97.24
South East	99.29	92.36	99.00	98.67
South West	97.14	88.02	98.96	96.88
Tunisia	96.78	89.63	98.57	98.27

Note: The Table reports the percentage of the reference category

[15] For this case, only 20 mothers surveyed in this region has replied to the question concerning the Immunizations taken; therefore the percentage illustrated in the table don't reflect the deteriorated situation in health outcome in this region.

Table 3: Descriptive Statistics of Circumstance Variables (By Region) (2011/12)

Region	Residence Area	Gender of Child	Number of Children 0-5	Age of Household Head	Father's education	Mother's education	Economic Well-being	Most/Least Group
Grand Tunis	91.28	51.45	1.25(0.45) [1-3]	41.03(9.56) [24-98]	98.13	96.00	58.18	11.19/0.37
North East	50.53	55.88	1.30(0.53) [1-4]	41.42(9.67) [24-87]	96.42	92.01	38.54	6.09/6.45
North West	45.52	58.06	1.32(0.55) [1-4]	42.87(11.37) [23-93]	87.37	78.77	25.48	7.37/11.05
Centre East	71.86	52.54	1.34(0.58) [1-3]	39.97(9.23) [23.-76]	98.05	94.09	56.37	9.76/3.90
Kasserine	33.10	50.89	1.40(0.56) [1-3]	40.97(10.61) [23-87]	90.16	73.13	12.94	1.55/21.24
Kairouan	42.14	56.86	1.45(0.60) [1-3]	42.61(10.97) [24-87]	89.45	67.48	15.05	4.02/19.10
Sidi Bouzid	31.97	54.51	1.38(0.59) [1-4]	42.87(11.45) [25-91]	85.88	66.29	15.73	4.12/15.88
South East	73.08	50.30	1.38(0.58) [1-3]	42.22(11.19) [24-90]	97.45	90.20	39.59	4.26/5.53
South West	69.76	50.81	1.28(0.50) [1-4]	43.42(10.97) [23-83]	93.48	88.08	37.82	5.43/6.52
Tunisia	57.70	53.48	5.10(1.97) [3-12]	41.85(10.54) [23-98]	93.50	84.14	34.88	6.19/9.31

Note: The Table reports the mean. the standard deviation (in parenthesis) and the minimum and maximum values (in brackets) of each quantitative variable. For the dummy variables. we just report the percentage of the reference category (Male, Urban, Educational level , Wealthy classes).

Appendices

Table A1: Summary of Human Opportunity Index on Selected Indicators for Tunisia

	Outcome	Coverage (C)	Penalty (P)	Dissimilarity (D)	Equality (E)	HOI
HEALTH	HEA1	97.61	1.45	1.48	98.52	96.16
	Antenatal Care	97.77	1.56	1.6	98.4	96.21
	Birth place	98.78	1	1.01	98.99	97.78
	Birth attented by professionals	96.28	1.39	1.45	98.55	94.89
	Check up posnatal	99.61	0.34	0.34	99.66	99.27
	Immunizations	93.62	3.85	4.11	95.89	89.77
	HEA3	35.56	13.04	36.66	63.34	22.52
	Access to water	59.19	8.14	13.76	86.24	51.04
	Access to sewage facilities	53.47	19.25	36	64	34.22
NUTRITION	NUT1	89.72	1.44	1.61	98.39	88.28
	Stunting	91.59	1.59	1.74	98.26	89.99
	Wasting	98.36	0.61	0.62	99.38	97.75
	Underweight	98.51	0.47	0.47	99.53	98.04
	Blood tests	96.78	1.26	1.3	98.7	95.52

Source : Author's calculations; All values are in percentage.