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# On measuring and decomposing inequality of opportunity in access to health services among Tunisian children: a new approach for public policy

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## Abstract

**Background:** The early years in children's life are the key to physical, cognitive-language, and, socio-emotional skills development. So, it is of paramount importance in this period to be interested in different indicators that would influence the child's health.

**Methods:** This paper measures inequality of opportunities among Tunisian children concerning access to nutritional and healthy services using Human Opportunity-Index and Shapely decomposition methods.

**Results:** Many disparities between regions have been detected since 1982 until 2012. Tunisian children face unequal opportunities to develop in terms of health, nutrition, cognitive, social, and emotional development. Likewise, we found that, parents' education, wealth, age of household head and geographic factors as key factors determining child development outcomes.

**Conclusion:** Our findings suggested that childhood unequal opportunities in Tunisia are explained by pension funds deficiency and structural problem in the labor market.

**Trial registration:** The results of a health care intervention on human participants "retrospectively registered".

**Keywords:** Inequality of opportunity, Dissimilarity index, Tunisia, Children

**JEL classification:** D63, D30

## Background

World Development Organizations seek to reduce the proportion of people who suffer from hunger. A reduction in the prevalence of malnutrition can contribute to the reduction of infant mortality. However, countries tend to under-invest in this stage of development, particularly in developing countries. Inequality of opportunity in early childhood is studied across the early life course and is often quantified until age five in terms of health, nutrition, social-emotional development, early learning, and early work and

explained by many circumstances such as access to health services.

Likewise, a reduced regional disparity is an important determinant of long run growth and development and contributes to guarantee political and economical stability. Furthermore, variation in disease environments could contribute to inequality in health outcomes related to place of residence [1].

Despite the importance of early childhood, there is limited research on the state of early childhood development and inequality in Tunisia. This issue is frequently absent from political agendas, insufficiently researched, and under-resourced. In this paper, we

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examine the inequality of opportunity that children in Tunisia face in early childhood across a variety of basic services access and decompose inequality of opportunity in order to identify its determinants. This analysis not only contributes to the improvement of limited research on early children development and inequality in Tunisia, but also provides critical information for identifying the vulnerable groups, key issues, and factors that limit children's development early in life. Our contribution is to take into consideration multidimensional aspects of inequality to overcome shortcomings linked to previous one-dimensional methodology.

Equality of opportunity is based on the distinction between efforts and circumstances that are under and beyond the individual's control [1, 2]. So unequal opportunities result from a big difference in circumstances such as: family background sex, place of birth... the ways of dealing with such circumstances have being unfair and require quick and efficient action from political decision makers. Constraints on access to services and basis resources contribute to perpetuate the lack of both capacities and opportunities in a large part of society [3, 2, 4].

The early years in the child's life cycle are considered as the fundamental starting point of inequality of opportunity at the physical cognitive and especially psychological level bearing in mind that these competencies develop early in life [5]. In other way, well-brought up and well surrounded children have better chances to develop their knowledge [6], communication, social competencies, and grow healthy while having high self-esteem [7, 8]. The early years of life have been described by some people as "a prolonged critical period and a real window opportunity for development that ends at three years stage" [9].

Underfeeding has a negative impact on economic and social development. Its effect can persist up to advanced stages in a human being's life and particularly children [9]. Throughout research, a number of studies show that biological and psycho-social risks affect individual development considerably by means of changes in structure and function of the brain which can lead to behavior changes, the latter will doubtlessly lead to a significant impact on the life of the individual and society [10].

To assess the extent of inequality in early childhood, we draw on the concepts and methodology developed in the recent literature on inequality of opportunity (De [11, 12, 2, 13]). Using data from a surveys covering Tunisia, we examine the state of early childhood development in terms of early health services. We quantify the unequal opportunities children have to develop along health services using the dissimilarity index (De [11]) and decompose inequality into the contributions

of different circumstances using the Shapley decomposition [13].

Inequality of opportunity in Tunisia is particularly high in access to health services between regions and in activities that support early cognitive development, which has important implications for inequality in children's subsequent labor force. Our analysis also illustrates the pathways through which circumstances shape children's early opportunities. Overall, wealth, mother's education, and geographic differences tend to contribute substantially to inequality of opportunity. This paper is the first paper that measures inequality of opportunities among children in Tunisia on selected health utilization, nutrition indicators using the Human Opportunity Index (HOI), which is a measure of inequality of opportunity in basic services for children.

Before presenting our findings in section 4, we organized our paper as follow: In section 2, we present a conceptual framework for inequality of opportunity in early childhood development. Section 3 describes our empirical strategy and discusses the surveys and samples. Finally, section 5 provides implications of our findings and conclusions.

### A conceptual framework

Based on the philosophical works elaborated by Rawls [14], Sen. [15], Dworkin [16, 17], Cohen [18]; Arenson [19] and Roemer [20, 2], was the first to have introduced the concept of equality of chances in the economic literature. They distinguished between effort and circumstances in explaining divergences in wealth an opportunity in adulthood. The circumstances are defined as factors on which individuals have no control such as: ethnical origin sex, age, parental education...etc. This inequality of chances is widely considered unfair and deserving of attention from policy makers.

Our approach in this paper is based on Roemer's frameworks (1998) who present "model of advantage" to decompose outcomes into a controllable part (effort) and a non controllable condition(circumstances) that the States must intervene to reduce in order to guaranty social equity. This model can be presented as follow:

$$y = f(C, E, u) \quad (1)$$

Where  $y$ , designates the considered outcome,  $C$  and  $E$  are respectively vectors of circumstances and effort variables and  $u$  represents the random factors. As noted above, Roemer's theory (1998) presumes explicitly that circumstances must be economically exogenous i.e. the person can't control over them. Conversely, efforts may be endogenous and may therefore depend on circumstances as shown in the following equation:

$$y = f[C, E(c, v), u] \quad (2)$$

According to Roemer, realizing an equality of opportunities requires that  $F(y/C) = F(y)$  which means simultaneously that no circumstance variable should have a direct causal impact on variable  $y$  ( $\partial f(C, E, u) / \partial C = 0$ ), each effort variable should be distributed independently from all circumstances  $G(y/C) = G(y)$ . Furthermore, Random factors are independent from circumstances  $H(y/C) = H(y)$  where all three functions  $F$ ,  $G$  and  $H$  denote cumulative distributions. Subsequently, an inequality of opportunity occurred when  $F(y/C) \neq F(y)$  and the extent of this inequality could be measured by the difference between the two members of the previous inequality. This last inequality has been defined as Roemer's strong definition of inequality of opportunity in a several recent papers, including Bourguignon et al. [3]; Ferreira and Gignoux [21].

So, earlier literature seeking to separate the effect of efforts from circumstances (out of control) has led to the emergence of the concept "Human opportunity index". It corresponds to a synthetic measure of opportunities inequality, proposed for the first time by the social welfare function of Sen [22] and developed by the World Bank on 2006. This index is firstly applied to measure inequality of opportunity in access to basic services in Latin America and Caraib by De Barro and al., [23]. Since then, this measure has been widely used in the literature of inequalities but the results are different may be because of the used measures of inequalities. This tool has the advantage of giving an idea on the level of accessibility to any service by a given population and gives the level of discrepancies in sample in terms of access to this service. In other words, it helps respond to these preoccupations: (i) How many opportunities are available to a childhood in any region of a given country (the coverage rate by a basic service). (ii) How equitably those opportunities are distributed (whether the dissimilarity in individual access to the same service is due to exogenous circumstances and inequality of chances). We are largely based on the idea presented in this section in developing our methodology. We constructed a conceptual and empirical frameworks permitting us explain inequality in access to basic services by Tunisian children.

## Data and methodology

### Data choice and descriptions

We use data from the Multiple Indicator Cluster Surveys (MICS4), this survey was executed in 2011-2012 by the Ministry of Development and Cooperation with the National Institute of Statistics of Tunisia (INS), financial and technical support was provided by the United Nations Children's Emergency Fund (UNICEF),

the United Nations Population Fund (UNFPA) and the Swiss Cooperation Office in Tunisia. It is the only recent database available until our day, which contains rich information on the situation of women and children in this country.

We use also data concerning place of residence, socio-economic and demographic indicators for three governorates of the center (Kasserine, Kairouan and Zidi-Bouzyd) and for six regions of the country (District Tunis, North East, North West, Center East, South East and South West). Otherwise, we use 8 variables of circumstances: residence, age of household's head, family wealth index, sex of household head, gender, number of children per household, level of education of household head and household size.

Firstly, to study nutrition situation of Tunisian children we are based on a sample of 9600 selected households where 2938 children under 5 years were identified through the household question sheet. This question sheet was filled for 2768 of these children, which corresponds to a 94.2% answer rate among households with children under 5 years interviewed [24]. Descriptive statistics containing demographic information about of this sample are presented in the Table 10 Appendix. Then, to analyze the development of babies' health in Tunisia, we use crucial index measuring opportunity access to basic services using data provided by the INS (2011-2012). The database covers 9867 women interviewed, of whom 4204 gave birth and 1059 gave birth during the last 2 years before the interview. The first sample of women, that have had children since 1982 until 2012, allows us to see the disparities in terms of access to basic health services for children. The last database which contains 1059 women who gave birth in the last years preceding the questionnaire is important in the sense that it allows us to follow the evolution of inequalities of chances in relation to previous years.

For the choice of our variables, we are based on important indicators and outcomes identified in previous literature, and as constrained by the data availability, we considered nutritional and health care utilization variables as our proxy for health services access.

The nutritional status of children is a reflection of their overall health. When children have access to adequate food, are not exposed to repeated morbid episodes and are healthy, they reach their growth potential and are considered well fed. Malnutrition is responsible for more than half of all child deaths worldwide. Undernourished children are more likely to die from common childhood illnesses and those who survive have recurrent diseases and stunted growth. One of the main goals of World Health Organization is to reduce the proportion of people who suffer from

hunger. A reduction in the prevalence of malnutrition will also help to reduce infant mortality. In a well-nourished population, there is a reference distribution of the size and weight of children under 5 years of age. Under-nutrition in a population can be measured by comparing children to the reference population. The reference population used in this work is based on the WHO growth standards. Each of the three indicators of nutritional status can be expressed in units of standard deviations (reduced deviation) from the median of the reference population (Tables 13 and 14 in the Appendix).

**Weight-for-age** is a measure of both acute and chronic malnutrition. Children whose weight-for-age is more than two standard deviations below the median of the reference population are considered to be low or moderate underweight, while those whose weight-for-age is more than three standard deviations below the median are considered to be severely underweight (Table 13).

**The length-for-age** is a measure of linear growth. Children whose height-for-age is more than two standard deviations below the median of the reference population are considered to be too small for their age and are classified as having moderate or severe growth retardation. Those whose height-for-age is more than three standard deviations below the median are classified as having severe growth retardation. Stunting is a reflection of chronic malnutrition resulting from lack of adequate nutrition over a long period of time and from recurrent or chronic diseases (Table 13).

Finally, children whose **weight-for-height** is more than two standard deviations below the median of the reference population are classified as moderately or severely emaciated, while those with more than three standard deviations below the median are considered severely emaciated. Emaciation is generally the result of a recent nutritional deficiency. The indicator may have significant seasonal variations associated with changes in food availability or disease prevalence (Table 14).

Table 1 shows the percentages of children in each of these categories, based on the anthropometric measurements taken during the fieldwork. Based on the new WHO growth standards,<sup>1</sup> 2.57% of children under 5 years old in Tunisia are underweight (moderate or severe). Approximately one of ten children (10.33%) suffers from moderate or severe stunting and 2.2% are moderately or severely emaciated.

There are also variations in anthropometric indicators according to socio-demographic characteristics; boys appear to be slightly more likely than girls to acquire underweight, stunting, and emaciation. Disparities by environment are characterized by a higher

prevalence of moderate or severe growth retardation in rural areas ( $\approx 14\%$ ) than in urban areas (8%). In terms of geographical variations, we can see a higher prevalence of underweight in the South West, Sidi Bouzid, Kairouan and North West (4%), while the prevalence of moderate or severe growth problem is touched in Kasserine (13.83%), in south-west, sidi bouzid, kairouan and north-west (more than 13%).

Children whose mothers/guardians with secondary or superior education are the least likely to be underweight and stunted compared to the children of mothers who have never attended school. As for the disparities according to the level of economic well-being, the prevalence of underweight and stunting are higher among the poorest.

Similarly, the prenatal period offers important opportunities to provide services that may be essential to the health of pregnant women and their infants [25]. A better understanding of the growth and development of the fetus and its relationship to maternal health has led to increased attention to prenatal care, which has been widely demonstrated to have an impact on improving maternal and neonatal health. For example, if the prenatal period is used to inform women and families about warning signs, symptoms and risks related to labor and delivery, it can guide women to give birth in the best possible way with the assistance of qualified care personnel. The prenatal period also provides an opportunity to provide information on birth spacing, recognized as an important factor in improving infant survival. Tetanus vaccination during pregnancy can save both mother and infant life. Preventing and treating malaria in pregnant women, managing anemia during pregnancy and treating STIs (sexually transmitted infections) can greatly improve the chances of survival of the fetus and the health of the mother. Adverse outcomes such as low birth weight can be prevented through a combination of interventions to improve the nutritional status of women and prevent infections (eg, malaria and STIs) during pregnancy. More recently, the potential of the prenatal period as an entry point for the prevention of HIV (Human Immunodeficiency Virus) and care, especially for the prevention of mother-to-child transmission of HIV, has led to renewed interest in the access and use of prenatal care services.

World Health Organization recommends a minimum of four antenatal visits based on an analysis of the effectiveness of different antenatal care models. WHO guidelines are specific to the content of prenatal consultations, including: measurement of blood pressure; Urine analysis for bacteriuria and proteinuria; Blood testing to detect syphilis and severe anemia; and weight/length measurement (optional).

**Table 1** Basic characteristics of children under 5 years according to selected characteristics (Nutrition)

Tunisia (2011-2012)		Nutrition: Weight for Age			Nutrition: Height for Age		Nutrition: Weight for height	
		Underweight		No ponderal insufficiency	Growth delay	No growth delay	Emarciation	No emarciation
Total		2768	71	2697	286	2482	61	2707
		100.00	2.57	97.43	10.33	89.67	2.20	97.80
Gender	Male	1482	48	1434	163	1319	40	1442
		53.54	3.24	96.76	11.00	89.00	2.70	97.30
Female		1286	23	1263	123	1163	21	1265
		46.46	1.79	98.21	9.56	90.44	1.63	98.37
Residence	Urban	1607	41	1566	126	1481	38	1569
		58.06	2.55	97.45	7.84	92.16	2.36	97.64
Rural		1161	30	1131	160	1001	23	1138
		41.94	2.58	97.42	13.78	86.22	1.98	98.02
Region	District Tunis	356	5	351	24	332	10	346
		12.86	1.40	98.60	6.74	93.26	2.81	97.19
North East		379	8	371	37	342	6	373
		13.69	2.11	97.89	9.76	90.24	1.58	98.42
North west		291	10	281	38	253	4	287
		10.51	3.44	96.56	13.06	86.94	1.37	98.63
Centre East		308	5	303	18	290	8	300
		11.13	1.62	98.38	5.84	94.16	2.60	97.40
Kasserine		282	5	277	39	243	7	275
		10.19	1.77	98.23	13.83	86.17	.48	97.52
Kairouan		305	11	294	40	265	5	300
		11.02	3.61	96.39	13.11	86.89	1.64	98.36
Sidi Bouzid		250	10	240	33	217	6	244
		9.03	4.00	96.00	13.20	86.80	2.40	97.60
South East		347	6	341	24	323	9	338
		12.54	1.73	98.27	6.92	93.08	2.59	97.41
South Ouest		250	11	239	33	217	6	244
		9.03	4.40	95.60	13.20	86.80	2.40	97.60
Mather's education	Nothingness	466	21	445	79	387	9	457
		16.84	4.51	95.49	16.95	83.05	1.93	98.07
Primary and similar		917	16	901	101	816	17	900
		33.13	1.74	98.26	11.01	88.99	1.85	98.15
Secondary and similar		951	23	928	79	872	21	930
		34.36	2.42	97.58	8.31	91.69	2.21	97.79
Superior		434	11	423	27	407	14	420
		15.68	2.53	97.47	6.22	93.78	3.23	96.77
Annual family incomes (Economic quintile)	The poorest	737	30	707	118	619	13	724
		26.63	4.07	95.93	16.01	83.99	1.76	98.24
Second		606	11	595	72	534	14	592
		21.89	1.82	98.18	11.88	88.12	2.31	97.69
Medium		479	11	468	29	450	9	470
		17.30	2.30	97.70	6.05	93.95	1.88	98.12
Fourth		565	11	554	46	519	13	552
		20.41	1.95	98.05	8.14	91.86	2.30	97.70
The richest		381	8	373	21	360	12	369
		13.76	2.10	97.90	5.51	94.49	3.15	96.85

The second value in the table corresponds to the percentage contribution in the corresponding sample

In this framework, we present the level of health care coverage in Table 2 and the type of staff providing prenatal care to women aged 15-49 who gave

birth in the two years preceding the survey in Table 15 Appendix. This table shows that access to antenatal care is relatively high in the country as a whole



**Table 2** Basic characteristics of children under 5 years according to selected characteristics (Health) (Continued)

Annual family incomes (Economic quintile)	The poorest	57.40	77.48	22.52	78.10	21.90	86.69	13.31	52.40	2.16	97.84	4.86	95.14	42.16	57.84
		1047	774	273	785	262	904	143	288	15	273	26	262	145	143
		24.93	73.93	26.07	74.98	25.02	86.34	13.66	27.20	5.21	94.79	9.03	90.97	50.35	49.65
	second	850	622	228	632	218	720	130	230	2	228	12	218	100	130
		20.24	73.18	26.82	74.35	25.65	84.71	15.29	21.72	0.87	99.13	5.22	94.78	43.48	56.52
	medium	774	600	174	608	166	680	94	179	5	174	13	166	85	94
		18.43	77.52	22.48	78.55	21.45	87.86	12.14	16.90	2.79	97.21	7.26	92.74	47.49	52.51
	fourth	791	571	220	574	217	659	132	221	1	220	4	217	89	132
		18.83	72.19	27.81	72.57	27.43	83.31	16.69	20.87	0.45	99.55	1.81	98.19	40.27	59.73
	the richest	738	597	141	599	139	635	103	141	0	141	2	139	38	103
		17.57	80.89	19.11	81.17	18.83	86.04	13.96	13.31	0.00	100.00	1.42	98.58	26.95	73.05

The second value in the table corresponds to the percentage contribution in the corresponding sample

with 97.83% of women receiving prenatal care at least one time during pregnancy (79.03% per doctor and 44.47% per auxiliary midwife). The highest levels of prenatal care are observed in the South East and South West regions (100%); while the lowest level is in the Sidi Bouzid region (89.36%). There are few differences among children following residence (98.50% in urban areas versus 96.94% in rural areas). This coverage is around 97.06% for boys and 98.64% for girls. It increases with women's educational attainment (from 95.55 to 100%) and the level of economic well-being of households. Of the women surveyed and concerned with antenatal care, 79.03% were examined by a physician during pregnancy; this proportion is higher in urban areas (82.69%) than in rural areas (74.23%). It is higher among women residing in the Central East region (93.57%), women with university education (93.10%), and women in the richest household category (97.87%). The lowest proportions were found among women who had never attended school (67.04%) and those in the governorate of Kairouan (67.50%) and the South West region (68.57%). This level of coverage has been low in previous decades and is approaching an average of 25% throughout the study period. The distribution is similar for blood samples with a slight decrease in the level of coverage, which drops to 94.62% in 2012 and does not exceed 24% (23.86%) over the period from 1982 until the date of the survey always with a small advantage of the southern regions.

In Tunisia, two postnatal consultations are recommended: on the eighth and fortieth day after childbirth [26]. However, no question on these two visits is included in the questionnaire. This survey revealed that 85.67% of newborns had no postnatal consultation during the first 6 days after birth between 1982 and 2012, while 43.15% born in the 2 years prior to the survey received no postnatal care (Table 2). This percentage is the highest in Sidi Bouzid (88.22% over the entire period and 56.38% in 2012) and it is the lowest in the Center East (81.80 and 20.18%). There are few differences on average between urban areas (86.64%) and rural areas (84.06%). This percentage decreases with the level of economic well-being and with the level of schooling of the mother.

### Methodology

As indicated previously, we aim to study inequality in early childhood access to basic services. Otherwise, our variables of interest are binary meaning two possibilities either access or not. So, we follow De Barros [23], Son [27] to define a dichotomous variable  $z_i$  which takes a value of 1 if the  $i$ th person of specific group has access to basic opportunity and

takes a value of 0 if he lacks access to the considered opportunity. It can be readily proved that  $(z_i) = p_i = (z_i)$ , where  $p_i$  is the average accomplishment related to the dichotomous outcome ( $z_i$ ) with respect to a specific group of sample.  $p_i$  could be defined otherwise as the probability that the  $i$ th person has access to a given opportunity. It depends on a vector of exogenous variables indicating the socioeconomic circumstances (such as gender, age, area of residence...) of each group, the total characteristic being  $k$ . There can be as many probability gaps between individuals/groups as there are possible combinations of group-identifying circumstances (income groups, household-size groups, gender groups...).

Given a set of  $k$  circumstance variables  $x_{i1}, x_{i2}, \dots, x_{ik}$ , we estimate the probability  $p_i$  for each child (In this study we focus particularly on children as we assume that many of the differences in opportunities are generated during childhood and carried out the whole life) by means of a logit model. Accordingly, we have the following expression of:

$$p_i = \frac{e^{\left(\beta_0 + \sum_{j=1}^k \beta_j x_{ij}\right)}}{1 + e^{\left(\beta_0 + \sum_{j=1}^k \beta_j x_{ij}\right)}} \quad (3)$$

Secondly, we compute the overall coverage rate  $\bar{p}$  which is the proportion of the population with access to a given opportunity using the following formula:

$$\bar{p} = \sum_{i=1}^n w_i \hat{p}_i \quad (4)$$

Where  $w_i = \frac{1}{n}$  and  $n$  is the size of sample considered. Then, the Dissimilarity Index  $D$  can be computed as follows:

$$\hat{D} = \frac{1}{2\bar{p}} \sum_{i=1}^k w_i \left| \hat{p}_i - \bar{p} \right| \quad (5)$$

After calculating the penalty which is equal to  $P = C \times D$ , we get the final formula of the HOI for each service or outcome:

$$HOI = \bar{p} (1-D) \quad (6)$$

Human opportunity index specification provides an overview in the differences between regions in terms of percentage coverage by any service in addition to dissimilarity level but it is silent about origin of inequality. To overtake this limit, we refer to **Shapley Decomposition methodology that consists in identifying how each circumstance "contributes" to**

### Inequality in access to basic services [28, 29, 13].<sup>2</sup>

This approach extends the idea of the Shapley value of cooperative games into applications for decomposing inequality. The decomposition consists of calculating the marginal contributions of each circumstance as they are removed in sequence. Following Barros et al. [11], and [13], we can measure inequality of opportunities by the penalty (P) or by the dissimilarity index (D), as defined in expressions (4) and (5) above. The value of these two measures—where P is just a scalar transformation of D—is dependent on the set of circumstances considered. Moreover, they have the important property that adding more circumstances always increases the value of P and D. If we have two sets of circumstances A and B, and set A and B do not overlap, then  $HOI(A,B) \leq HOI(A)$ ; and alternatively,  $D(A,B) \geq D(A)$ . The impact of adding a circumstance A is given by:

$$[D(s\{A\})-D(S)]$$

$$D_A = \sum_{S \subseteq N \setminus \{A\}} \frac{|s|(n-|S|-1)!}{n!} [D(S \cup \{A\})-D(S)] \quad (7)$$

Where  $N$  is the set of all circumstances, which includes  $n$  circumstances in total;  $S$  is a subset of  $N$  that does not contain the particular circumstance  $A$ .  $D(S)$  is the dissimilarity index estimated with the set of circumstances  $S$ .  $D(S \cup \{A\})$  is the dissimilarity index calculated with set of circumstances  $S$  and the circumstance  $A$ . The contribution of circumstance  $A$  to the dissimilarity index can be defined as:

$$M_A = \frac{D_A}{D(N)} \text{ where } \sum_{i \in N} M_i = 1 \quad (8)$$

We measure variations in HOI in Tunisia in the time period surveyed based on 2 main indicator categories: (i) Malnutrition Intake, and (ii) Healthcare utilization before, during pregnancy to healthcare services in early year using data from the 2011 and 2012 (MICS4) samples.

### Results and discussions

We present our results and interpretations in terms of coverage beginning by the nutritional status of children in Tunisia during the period of the survey elaboration then by access to health care services before, after, and during pregnancy.

### Access to nutritional services by Tunisian childhood

#### Results

Given the importance of nutrition and its influence on the health status and early childhood mortality rate, it should be noted that in a well-nourished population there is a standard distribution of the height and weight of children less than five years aged. Under-nutrition in a population can be measured by comparing children to the reference population.<sup>3</sup> Stunting indicates accumulated malnutrition, damages psycho-social development [30] and engenders poorer school performance leading to lower productivity and so wages later in life, according to classical theory [31]. Indeed, it results that there are variations of the anthropometric indicators according to the socio-demographic characteristics.

Table 3 shows that for the first model, when we consider weight for age ratio as the dependent variable, household's size increase significantly at the 5% threshold underweight problem.<sup>4</sup> However, head's household age, number of children (2-14) per household and head's household education level decreases significantly the probability of children to suffer from problem of underweight. Concerning determinants of children's stunting, it seems that household's education level, high family income, male nature and age of head's household significantly reduces the likelihood to have problem of growth during the first five years of birth (second column). Similarly, a child who belongs to a large family may significantly have problems of emaciation, whereas if he or she lives with more than one child (2-14) he or she becomes more protected against this type of problem (last column).

Table 4 presents results of HOI regressions which give an idea about nutritional status of children in each region in the Tunisian areas. If we interpret our results in terms of coverage, we can see that it is almost satisfactory for the 3 indicators of nutrition such as weight for age, height for age and weight for height are respectively 97.43%, 89.66%, and 97.79%.

The first indicator that measures both acute and chronic malnutrition (weight-for-age) is 97.43% meaning that 97.43% of children among all population of reference have the opportunity to be well nourished. The corresponding D-index (which measures inequality) implies that 0.6% of opportunities must be redistributed fairly to ensure equality of opportunity in terms of protection against malnutrition. Thus, associated HOI which is coverage penalized for inequality ( $C * (1-D)$ ) is estimated to be 96.8%.

Concerning height for age which measures linear growth, we can see that 89.66% of Tunisian's children have the opportunity to grow normally with a slow D-index of 2.18% and a HOI of 87.71%. Finally, the latest

**Table 3** Results of logit model (Nutrition)

Endogenous variables Exogenous Variables	Nutrition: Weight for Age		Nutrition: Height for Age		Nutrition: Weight for height	
	Coef	P-Value	Coef	P-Value	Coef	P-Value
Gender	-.041	0.865	-.033	0.794	-.315	0.233
Residence	-.488	0.103	.191	0.208	-.166	0.610
Head's household Education	.865	0.022	.565	0.004	.418	0.368
Household income	.355	0.228	.605	0.000	-.110	0.727
Head's household gender	-1.07	0.294	.747	0.003	-1.00	0.331
Household size	-.417	0.000	-.064	0.256	-.227	0.023
Number of children (2-14)	.288	0.011	.014	0.828	.415	0.002
Head's household age	.063	0.000	.019	0.009	.024	0.131
Constant	3.13	0.010	.128	0.763	4.16	0.001
Obs	2768		2768		2768	
Prob > chi2	0.0000		0.0000		0.0543	

nutritional weight-for-height indicator (which measures emaciation) shows a coverage rate of 97.79%. That is, 97.79% of children in Tunisia have the opportunity to be sufficiently and efficiently nourished.

Despite the high level of anthropometric indicators throughout the country, there is a disparity between regions. Indeed, weight-for-age (which detects both acute and chronic malnutrition) is found to be low in inland areas compared to littoral regions. For example, in Sidi Bouzid, in the South West, in Kairouan and in the North West, 95.74%; 95.03%; 96.23% and 95.55% are respectively found, while in district Tunis and in the Center East we find 98.10% and 98.26%, respectively.

Similarly, height for age which is a linear growth indicator and weight-for-age (the indicator of emaciation) are also low in western and inland regions (such as

kairouan and sidi bouzid and middle west) than in regions in the east of the country (littoral) as shown in the Table 4 below, showing the regional coverage for 3 nutritional indicators.

Otherwise, Table 4 shows that anthropometric indicators vary according to socio-demographic and regional criteria in Tunisia. Despite good nutritional indices at the national level, it seems that there are many regional imbalances and disparities in access to these primary services. In this sense, it appears that children in the western, southwestern regions (with low coverage) are more susceptible to suffer from stunting, problems of emaciation and underweight (Malnutrition). For example, South west region presents the lowest rate of coverage against stunting problem (only 86.25% of children are protected) while the center east present the highest level of coverage (with more than 94.00%). Concerning dissimilarity at the same region, we note that children of the center east are more meaning that they have comparable chances to be covered against stunting (less than 1%). For children living in North West and Kairouan inequality between childhoods in terms of protection against nutritional problems is again remarkable (D-index = 4.95% for stunting problem in Kairouan). To give sense to our analysis and searching to quantify the contribution of circumstances variables in explaining inequality we are based on the Shapley decomposition and results are presented below:

Table 5 illustrates a Shapley decomposition result which consists at identifying sources of dissimilarity in terms of anthropometric services. From this table, it appears that the "household size" best explains both acute and chronic malnutrition of children followed by 'head's household age'. This result confirms our conclusions

**Table 4** Rate of anthropometric indicators coverage by region

	Weight for age (Malnutrition %)	Height for age (stunting %)	Weight for height (Emaciation)
Great Tunis	98.10 (0.63)	93.25 (2.12)	96.21 (0.69)
North East	97.80 (0.82)	90.23 (2.7)	98.24 (0.40)
North West	95.55 (2.13)	86.94 (4.94)	98.15 (0.47)
Center east	98.26 (0.79)	94.15 (0.90)	97.22 (1.03)
Kasserine	98.15 (1.06)	86.17 (2.52)	97.41 (0.96)
Kairouan	96.23 (2.30)	86.88 (4.95)	98.28 (1.16)
Sidi Bouzid	95.74 (1.5)	86.80 (3.47)	97.02 (1.71)
South East	98.07 (0.42)	93.08 (2.16)	97.32 (1.21)
South West	95.02 (1.63)	86.25 (2.83)	97.28 (1.07)
Tunisia	97.43 (0.6)	89.66 (2.18)	97.79 (0.42)

Numbers in parenthesis are corresponding D-index values

**Table 5** Shapely decomposition of regional nutritional disparities by circumstances

	Gender	Residence	Head's household education	Wealth index	Household gender	Household size	Head's Household age	Household Number of children per household	All regions
Weight for age (malnutrition)	0.79	2.44	10.42	15.33	5.40	37.27	23.57	4.73	35.26
Height for age (stunting)	0.16	25.49	11.71	43.58	8.01	4.76	2.55	3.71	22.31
Weight for height (Emaciation)	16.05	5.16	3.72	4.97	7.42	7.35	7.89	47.39	22.50

based on Table 3 such as this two variables are strongly significant in explaining malnutrition of Tunisian's children. For stunting situation, we can see that the main determinant of delays in children growth is the family economic situation and head's household education and that this finding is supported by the significance of these variables at the 5% threshold in Logit regression. Then, the number of child per household is an important factor explaining emaciation of early childhood in Tunisia. Furthermore, we note that the variables region is significant in explaining nutritional status of children meaning that people living in the west are favored than the rest of citizens (Table 10 Appendix).

### Discussions

Our results show that inequalities in terms of nutritional conditions are largely explained by economic indicators such as wealth index or number of children per household. These variables are different between eastern and western regions (Table 10 Appendix) which explains differences in terms of coverage and dissimilarity in access to basic nutritional services presented in Table 4.

In one hand, the western regions are of low demographic concentration compared to the coastal regions. On the other hand, the households living in these regions are mostly in rural areas which are characterized by a delicate financial situation and a low income (In some families no one have a permanent work). For example, the poorest family income represent 58.08% in Sidi Bouzid against only 10.06% in Center east (Table 10 Appendix). In addition to the lack of investment in these regions (compared to coastal regions which seduce investors), basic infrastructure and public health institutions are inexistent or under developed (for example access to potable water is 70.22% in district Tunisia but does not exceed 36% in Sidi Bouzid or 44.59% in Kairouan (Table 10 Appendix). Moreover these regions are characterized by a low level of parents' education reducing chance for child to receive appropriate

vaccine and nutrition. For example, women who have not received any training account for roughly 33% in kairouan and sidi sidi bouzid while in the center it is not more than 7%.

All these conditions influence the environment in which the child is born and is obliged to survive in a difficult nutritional situation affecting its intellectual capacities and productive skills. In rural area 13.78% of children are exposed to growth problem against 7.84% in urban regions (Table 1). These results can be explained by inefficient intervention of public authorities to overcome social problems and reduce differences of inequality between regions. In developing countries, such as Tunisia, the state is in the center of economy and public sector still dominates. So, inequality in access to basic service is largely explained by absence of an efficient and equitable policy of income redistribution by public authorities on the basis of a fiscal policy driven by high rates against the rich and subsidies addressed to the poorest agents. Private sector is still underdeveloped or embryonic and its role of redistribution of profits is non-existent or negligible because of inappropriate institutional framework or absence of good governance. Regions that are characterized by problem of economic growth, high levels of poverty and lack of infrastructure are characterized by childhood opportunity inequalities, reduced feelings of Non-membership and criminal in adulthood. Many statistics on terrorism consider Tunisia as leader in terms of terrorism explaining this phenomenon by poverty, lack of social equity and unequal opportunities. These latter can be more serious in adulthood because of the differences in efforts which themselves depend on circumstances uncontrollable by agents.

In order to test robustness of our findings, we present significance of each variables using Logit model regression by region in the appendices (Table 16 Appendix). We mainly conclude that head's household education, family income and head's household age matters in disadvantaged areas but does not arise in more developed regions in explaining nutritional

**Table 6** Results of logit model (Health)

Endogenous variables Exogenous Variables	Tunisia 1982-2012						Tunisia 2011-2012					
	Prenatal care		Blood samples		Postnatal care		Prenatal care		Blood samples		Postnatal care	
	Coef	P-Value	Coef	P-Value	Coef	P-Value	Coef	P-Value	Coef	P-Value	Coef	P-Value
Gender	.074	0.344	.099	0.209	.011	0.901	-.907	0.056	.002	0.993	-.115	0.359
Residence	-.267	0.006	-.243	0.012	-.275	0.017	-.272	0.616	.125	0.711	-.149	0.337
H-h Education	-.250	0.057	-.296	0.025	-.122	0.457	1.28	0.021	.146	0.738	.209	0.360
Wealth index	-.008	0.931	.012	0.895	.192	0.097	.570	0.337	.457	0.193	.372	0.015
H-h gender	.389	0.039	.386	0.043	.368	0.122	1.35	0.068	.652	0.271	.045	0.888
Household size	.345	0.000	.333	0.000	.331	0.000	-.205	0.245	-.144	0.225	.083	0.197
Number of children(2-14)	-.750	0.000	-.741	0.000	-.676	0.000	-.423	0.071	-.214	0.160	-.161	0.043
H-h age	-.112	0.000	-.111	0.000	-.107	0.000	.037	0.122	.012	0.452	-.013	0.073
Constant	3.27	0.000	3.19	0.000	2.07	0.000	2.27	0.074	2.41	0.013	.368	0.462
Obs	4200		4200		4200		1059		1059		1059	
Prob > chi2	0.0000		0.0000		0.0000		0.0000		0.0059		0.0122	

insufficiency. Results are largely similar to our main regressions and confirm our interpretations and conclusions.

#### Access to health care services before, after, and during pregnancy

As mentioned above, the use of prenatal and postnatal care and during pregnancy are very important for the development of the child. So, similarly to our demarche in subsection 4.1 in the case of nutritional status of Tunisian childhood, we begin by presenting results of logit model in order to specify principal determinants of each healthy indicator.

#### Results

Table 6 shows the results of Logit model regression when we consider health indicator variables as dependant variables. The second column shows that coefficients associated to the variables residence, head's household education, gender and age, household size, and numbers of children are statistically significant at the 10% threshold in explaining access to prenatal care during the full sample period. In 2012, residence and household's age become insignificant but we can see that male children have less possible access to prenatal service (the coefficient of gender variable is statistically significant at conventional level). Concerning blood sample during the period 1982-2012, we note that access to this service is totally explained by the same determinants of prenatal services but no variables are significant in 2012. Finally, access to postnatal care are largely explained by family income, number of children between 2 and 14 years and head's household age for our two subsample in addition to insignificant role

of residence and household size in 2012 compared to the full sample.

Table 7 shows that at the national level, access to the prenatal services is seen to be very limited, with 24.66% of mothers in Tunisia received prenatal services during the period from 1982 until 2012. In other words, almost a quarter of Tunisian children have the opportunity to access to prenatal care services. Therefore, D-index (which measures inequality) is high meaning that 27.95% of Tunisian prenatal services are granted in an unequal manner and need to be redistributed equally to ensure equal opportunities (Corresponding HOI is small and does not exceed 17.77%). Similarly for the other indicators, it was found that 23.85% of mothers received blood samples

**Table 7** Coverage rate of access to health indicators by regions (1982-2012)

Tunisia 1982-2012	Access to prenatal care %	Access to blood samples %	Access to postnatal care %
Great Tunis	20.98 (38.84)	20.66 (39.18)	12.40 (44.37)
North East	24.40 (33.32)	23.37(33.59)	17.23 (nn.29)
North West	21.51 (22.48)	20.54(21.74)	12.40 (30.19)
Center East	22.59(36.95)	21.54(36.40)	18.20 (39.24)
Kasserine	25.19(27.25)	23.91(29.18)	16.53(31.86)
Kairouan	32.32 (21.66)	31.78(21.79)	16.16 (24.21)
Sidi Bouzid	24.13(27.49)	22.70(26.04)	12.50 (31.51)
South East	28.81(25.10)	28.60(25.49)	12.07(18.19)
South West	25.42 (28.59)	24.69(28.23)	12.10(30.79)
Tunisia	24.66(27.95)	23.85(28.02)	14.33(30.76)

Numbers in parenthesis are corresponding D-index values

**Table 8** Coverage rate of access to health indicators by regions (2011-2012)

Tunis 2011-2012	Access to prenatal care %	Access to blood samples %	Access to postnatal care %
Coast regions	98.66 (.523)	96.00 (.834)	61.40(3.95)
Interior regions	96.99 (1.65)	93.24(2.06)	52.34(6.27)
Male	97.06(1.39)	94.67(1.60)	55.41(4.62)
Female	98.63(.693)	94.55 (1.20)	58.36(5.71)
Urban	98.50(.827)	96.00(.923)	58.06(3.73)
Rural	96.94 (1.18)	92.79(1.42)	55.24(6.95)
Nord	98.21(.710)	94.91(1.28)	61.83(5.52)
Center	98.10(.771)	94.56(1.46)	63.74(6.76)
South	93.97 (3.45)	94.32(2.30)	44.17(6.76)
Tunisia	97.82(.977)	94.61(1.32)	56.84(4.74)

Numbers in parenthesis are corresponding D-index values

to detect nutritional deficiencies in their offspring, and only 14.33% benefited from postnatal services such as midwifery or trained staff.

Despite the limited coverage rates in previous decades, the Tunisian Government has greatly improved its prenatal and postnatal services during the last few years. Table 8 shows that 97.82% and 94.61% of Tunisian childhood have access to prenatal care and blood sample, respectively, in 2012 with a small dissimilarity index (0.977%). But, the level of access to postnatal services remains low since half of the children do not have access to this service (only 56.84% have access to postnatal services).

Table 7 shows that there are important disparities between regions and socio-demographic neighborhoods in Tunisia during the period 1982-2012. This table shows that for access to prenatal services, most of the eastern regions of the country in addition to Kairoaun have higher coverage rate than the rest of the regions, ie children of these regions have most opportunity to access to these services compared to other regions. For example in Kairouan 32.32%, and in the South East 28.81% of child or (mother) received prenatal care (vaccinations), while in North

west 21.51% of concerned population have the chance to receive the same services with a high dissimilarity index in eastern region (for example D-index in center east is 36.95% which is very high for a country in the Mediterranean basin) meaning that most of childhood have not received the same opportunities to benefit from this service. In 2012, access to prenatal is improved in all regions approaching 100% and disparities are reduced with a small advantage of cost regions compared to interior regions (and urban region are more covered by this service). If we decompose Tunisian area into three great zones, we feel that southern governorates are less favored in access to prenatal services (HOI = 93.97% even that D-index is small and do not exceed 4% (Table 8).

For the other indicators, regional disparities in access to post-natal services and blood sampling are discarded. Indeed, for blood sampling, Sidi Bouzid and the South West have the lowest coverage rates and they also remain for the postnatal indicator during the full sample period. For the last indicator (postnatal care), only the Central East and North East regions have the highest rate. In 2012, there are no great differences between male and female in access to blood sample and post natal services. But, coast and urban regions are more covered by these services than others zones especially southern and interior regions.

To identify exogenous variable that contributes more to differences of inequality we presented Shapley decomposition results (Table 9). The main finding is that the variable "head's household age" is the most important to explain inequality of access to all health services during the last three decades. Surprisingly, this variable is the most significant in explaining discrepancy in terms of access to health services. Thus, an inequality grows over time and become very serious in adulthood or when agents become older. This reality can be, in part, explained by education level of the head's household but may also be the consequence of an inappropriate health system that does not care for the elderly. Many households are not

**Table 9** Decomposition of dissimilarity in access to health care services by circumstances

Tunisia: 1982-2012	Gender	Residence	Head's household education	Wealth index	Household gender	Household size	Household age	Number of children per household	All regions
Prenatal care	.716	4.38	2.03	2.03	1.82	8.44	44.67	30.13	5.76
Blood Samples	1.02	3.88	1.85	1.66	1.74	8.72	44.33	30.39	.363
Postnatal Care	.221	3.16	2.86	.248	2.05	8.84	46.78	28.21	7.59
Tunisia: 2012									
Prenatal care	10.61	5.88	13.47	12.22	6.64	15.28	2.60	25.56	7.69
Blood Samples	.296	13.31	3.35	20.93	3.58	19.08	2.06	25.84	11.51
Postnatal Care	4.62	4.16	8.29	21.89	1.94	6.58	13.42	12.48	26.57

part of the health insurance system and spend most of their working lives in black jobs. This fragile labor situation, generally without social contributions, leads to retirement age without social security benefits. Head's household age is again important in explaining access to post natal care but the variable "number of children (2-14)" prevails in 2012 in explaining opportunity' inequality in access to prenatal care and blood samples. In addition, we remark that family income begins to become important determinant of health services access in lat years. These conclusions are largely supported by results obtained by logit model regression (Table 6).

### Discussions

In fact, mothers who need more health care before, during and after pregnancy are in areas of low demographic or rural concentration, especially in the western and Southern regions and in Sidi Bouzid as we have already seen. Despite the similar level of coverage in some cases, the qualification of the officers performing this service differs widely across regions (Table 15 Appendix). Coverage rates are smaller compared to others regions. In addition residence, household education and wealth income are statistically significant in explaining access to health services in many regions of the south and west which is not the case for eastern region (Table 17 Appendix). Moreover, the infrastructure in these interior governorates is almost not-existent; hence moving for diagnosis is difficult for too old mothers. Health information and advices for the mother during the pregnancy phase are considered as a lever for the future development of the babies. However, women living in these areas have low levels of education. As a result, the prevalence of diseases caused by lack of health care has been observed among children from the poorest households and the least educated and elderly mothers.

As a conclusion, families characterized by numerous children and older head's household are more exposed to health problems in all the whole territory. In particular, the southern region are less favored in access to prenatal and postnatal care services in addition to the qualification of personnel ensuring this task. This fact can be explained by the absence of health schools and university hospitals in addition to specialized medicine in these regions.

### Conclusion and policy implications

Deficits and inequality early in life tend to accumulate and compound and lead to persistent shortfalls in human capital [32]. Based on a relatively few circumstances, which are entirely beyond of their

control, this paper has shown that, Tunisian children face unequal opportunities to develop in terms of health, nutrition, cognitive, social, and emotional development. Likewise, we found that, parents' education, wealth, age of household head and geographic factors as key factors determining child development outcomes.

Unequal provision of government services across different regions could contribute to geographic differences. Thus, it was recommended, among other things, that the government should, make periodic surveys on health status, on health care utilization, for financial reasons, Furthermore, to reduce financial constraint on access to care, through better targeting of the poor who should benefit from free medical assistance.

It was further recommended that efforts should be made by policymakers to help and encourage doctors to settle specially in disadvantaged region. Finally, and, on the institutional side: the policymakers should pursue new plan to reduce social and regional inequalities in access to health service in particular in rural areas.

As a final recommendation, Tunisian State must restructure the pension funds and provide free services to children whose heads of households are not members of the social funds. This policy can help reducing inequalities of opportunity in adult age and so reducing criminals and terrorism and enhances growth and development through increased productivity.

### Endnotes

<sup>1</sup>In 2006, WHO published growth standards for weight and height to replace the 1977 National Center of Health Statistics (NCHS).

<sup>2</sup>Chantreuil and Trannoy [28] and Sastre et Trannoy [29] applied Shapley decomposition methodology to explain only income inequality but Shorrocks [13] has shown that such a decomposition could be applied to any function.

<sup>3</sup>Each of the three indicators of nutritional status can be expressed in units of standard deviations (reduced deviation) from the median of the reference population. The reference population used in this paper is based on the WHO growth standards. [http://www.who.int/childgrowth/standards/second\\_set/technical\\_report\\_2.pdf](http://www.who.int/childgrowth/standards/second_set/technical_report_2.pdf). (Table A.3; A.4 and A.5 in appendix)

<sup>4</sup>When *P*-Value is less than 5% we can reject the null hypothesis meaning that the coefficient is not significant. So, we accept alternative hypothesis which means that the variable is statistically significant in explaining dependent variable.

**Appendix****Table 10** Sample's characteristics by regions (Nutrition)

Region	Gender		Residence		Household's education				Mother's education			
	Male	Female	Urban	Rural	Primary and similar	Secondary and similar	Superior	nothingness	Primary and similar	Secondary and similar	Superior	nothingness
Total	1482	1286	1607	1161	1135	956	350	327	917	951	434	466
	53.54	46.46	58.06	41.94	41.00	34.54	12.64	11.81	33.13	34.36	15.68	16.84
District Tunis	181	175	326	30	117	147	72	20	91	153	96	16
	50.84	49.16	91.57	8.43	32.87	41.29	20.22	5.62	25.56	42.98	26.97	4.49
Nord Est	212	167	193	186	169	126	54	30	128	165	54	32
	55.94	44.06	50.92	49.08	44.59	33.25	14.25	7.92	33.77	43.54	14.25	8.44
Nord Ouest	170	121	134	157	106	86	33	66	96	84	43	68
	58.42	41.58	46.05	53.95	36.43	29.55	11.34	22.68	32.99	28.87	14.78	23.37
Centre Est	164	144	222	86	127	112	47	22	97	113	75	23
	53.25	46.75	72.08	27.92	41.23	36.36	15.26	7.14	31.49	36.69	24.35	7.47
Kasserine	144	138	94	188	164	68	10	40	122	67	15	78
	51.06	48.94	33.33	66.67	58.16	24.11	3.55	14.18	43.26	23.76	5.32	27.66
Kairouan	171	134	129	176	119	106	29	51	114	68	21	102
	56.07	43.93	42.30	57.70	39.02	34.75	9.51	16.72	37.38	22.30	6.89	33.44
Sidi Bouzid	137	113	79	171	94	77	31	48	70	67	30	83
	54.80	45.20	31.60	68.40	37.60	30.80	12.40	19.20	28.00	26.80	12.00	33.20
Sud Est	175	172	255	92	138	138	46	25	112	146	57	32
	50.43	49.57	3.49	26.51	39.77	39.77	13.26	7.20	32.28	42.07	16.43	9.22
Sud Ouest	128	122	175	75	101	96	28	25	87	88	43	32
	51.20	48.80	70.00	30.00	40.40	38.40	11.20	10.00	34.80	35.20	17.20	12.80

**Table 10** Sample's characteristics by regions (Nutrition) (Continued)

Tunisia	Annual family incomes(Economic quintile)					Number of Children (2-14) at Home			Housing property			Waetr access: potable water	
	The poorest	second	medium	fourth	the richest	Less than 3	3 and mores	proprietor	location	Other	No access	access	
Region	737	606	479	565	381	1990	778	1970	480	318	1227	1541	
	26.63	21.89	17.30	20.41	13.76	71.89	28.11	71.17	17.34	11.49	44.33	55.67	
	11	57	75	95	118	290	66	174	114	68	106	250	
	3.09	16.01	21.07	26.69	33.15	81.46	18.53	48.88	32.02	19.10	29.78	70.22	
	63	91	75	84	66	310	69	278	56	45	153	226	
	16.62	24.01	19.79	22.16	17.41	81.79	18.2	73.35	14.78	11.87	40.37	59.63	
	80	76	67	41	27	217	74	207	57	27	108	183	
	27.49	26.12	23.02	14.09	9.28	74.57	25.43	71.13	19.59	9.28	37.11	62.89	
	31	58	51	100	68	232	76	218	78	12	126	182	
	10.06	18.83	16.56	32.47	22.08	75.32	24.68	70.78	25.32	3.90	40.91	59.09	
	123	92	35	25	7	174	108	179	29	74	103	179	
	43.62	32.62	12.41	8.87	2.48	61.70	38.30	63.48	10.28	26.24	36.52	63.48	
	165	59	36	38	7	192	113	242	31	32	169	136	
	54.10	19.34	11.80	12.46	2.30	62.95	37.05	79.34	10.16	10.49	55.41	44.59	
	147	41	26	21	15	162	88	198	28	24	160	90	
	58.80	16.40	10.40	8.40	6.00	64.80	35.2	79.20	11.20	9.60	64.00	36.00	
	57	76	68	99	47	245	102	274	48	25	212	135	
	16.43	21.90	19.60	28.53	13.54	70.61	29.39	78.96	13.83	7.21	61.10	38.90	
	60	56	46	62	26	168	82	200	39	11	90	160	
	24.00	22.40	18.40	24.80	10.40	67.20	32.8	80.00	15.60	4.40	36.00	64.00	

**Table 11** Sample's characteristics by region (Health: 1982-2012)

Région	Gender		Residence		Household's education			Mother's education				
	Male	Female	Urban	Rural	Primary and similar	Secondary and similar	Superior	nothingness	Primary and similar	Secondary and similar	Superior	nothingness
Total	2084	2116	2613	1587	1779	1380	443	598	645	538	201	405
	49.62	50.38	62.21	37.79	42.36	32.86	10.55	14.24	36.05	30.07	11.24	22.64
District Tunis	292	337	583	46	222	240	117	50	93	106	47	15
	46.42	53.58	92.69	7.31	35.29	38.16	18.60	7.95	35.63	40.61	18.01	5.75
Nord Est	313	273	362	224	267	201	64	54	91	85	26	22
	53.41	46.59	61.77	38.23	45.56	34.30	10.92	9.22	40.63	37.95	11.61	9.82
Nord Ouest	257	259	232	284	218	132	43	123	59	47	24	81
	49.81	50.19	44.96	55.04	42.2	25.5	8.33	23.84	27.96	22.27	11.37	38.39
Centre Est	244	234	353	125	206	170	68	34	80	70	41	19
	51.05	48.95	73.85	26.15	43.10	35.56	14.23	7.11	38.10	33.33	19.52	9.05
Kasserine	164	229	151	242	195	105	16	77	68	38	6	60
	41.73	58.27	38.42	61.58	49.62	26.72	4.07	19.59	39.53	22.09	3.49	34.88
Kairouan	202	163	161	204	146	110	25	84	55	37	9	56
	55.34	44.66	44.11	55.89	40.00	30.14	6.85	23.01	35.03	23.57	5.73	35.66
Sidi Bouzid	174	174	114	234	144	101	35	68	42	34	14	74
	50.00	50.00	32.76	67.24	41.38	29.02	10.06	19.54	25.61	20.73	8.54	45.12
Sud Est	227	245	356	116	212	171	41	48	88	77	19	40
	48.09	51.91	75.42	24.58	44.92	36.23	8.69	10.17	39.29	34.38	8.48	17.86
Sud Ouest	211	202	301	112	169	150	34	60	69	44	15	38
	51.09	48.91	72.88	27.12	40.92	36.32	8.23	14.53	41.57	26.51	9.04	22.89

**Table 11** Sample's characteristics by region (Health: 1982-2012) (Continued)

Tunisia 1982-2012	Annual family incomes(Economic quintile)					Number of Children (2-14) at Home		Housing property		Waetr access: potable water	
	The poorest	second	medium	fourth	the richest	Less than 3	3 and mores	proprietor	location	No access	access
Région	1047	850	774	791	738	3272	928	3224	605	1741	2459
	24.93	20.24	18.43	18.83	17.57	77.90	22.1	76.76	14.40	41.45	58.55
	18	98	125	136	252	534	95	374	165	183	446
	2.86	15.58	19.87	21.62	40.06	84.90	15.1	59.46	26.23	29.09	70.91
	77	123	137	119	130	499	87	451	76	216	370
	13.14	20.99	23.38	20.31	22.18	85.15	14.85	76.96	12.97	36.86	63.14
	171	118	112	71	44	421	95	400	69	197	319
	33.14	22.87	21.71	13.76	8.53	81.59	18.41	77.52	13.37	38.18	61.82
	60	70	81	142	125	381	97	368	95	178	300
	12.55	14.64	16.95	29.71	26.15	79.71	20.29	76.99	19.87	37.24	62.76
	172	107	50	38	26	267	126	282	38	141	252
	43.77	27.23	12.72	9.67	6.62	67.94	32.06	71.76	9.67	35.88	64.12
	192	76	45	44	8	253	112	303	35	185	180
	52.60	20.82	12.33	12.05	2.19	69.32	30.68	83.01	9.59	50.68	49.32
	199	59	38	31	21	239	109	296	35	216	132
	57.18	16.95	10.92	8.91	6.03	68.68	31.32	85.06	10.06	62.07	37.93
	75	111	101	117	68	362	110	394	50	282	190
	15.89	23.52	21.40	24.79	14.41	76.69	23.31	83.47	10.59	59.75	40.25
	83	88	85	93	64	316	97	356	42	143	270
	20.10	21.31	20.58	22.52	15.50	76.51	23.49	86.20	10.17	34.62	65.38

**Table 12** Sample's characteristics by region (Health: 2011–2012).

Région	Gender		Residence		Household's education			Mother's education				
	Male	Female	Urban	Rural	Primary and similar	Secondary and similar	Superior	nothingness	Primary and similar	Secondary and similar	Superior	nothingness
Total	545	514	601	458	414	378	136	131	172	157	87	88
	51.46	48.54	56.75	43.25	9.09	35.69	12.84	12.37	34.13	31.15	17.26	17.46
District Tunis	61	74	125	10	43	52	31	9	16	25	19	2
	45.19	54.81	92.59	7.41	31.85	38.52	22.96	6.67	25.81	40.32	30.65	3.23
Nord Est	83	63	69	77	63	52	18	13	26	21	10	5
	56.85	43.15	47.26	52.74	43.15	35.62	12.33	8.90	41.94	33.87	16.13	8.06
Nord Ouest	55	57	46	66	39	33	11	29	14	9	13	15
	49.11	50.89	41.07	58.93	34.82	29.46	9.82	25.89	27.45	17.65	25.49	29.41
Centre Est	62	47	77	32	40	41	22	6	19	15	19	3
	56.88	43.12	70.64	29.36	36.70	37.61	20.18	5.50	33.93	26.79	33.93	5.36
Kasserine	45	57	32	70	52	27	5	18	20	14	2	12
	44.12	55.88	31.37	68.63	50.98	26.47	4.90	17.65	41.67	29.17	4.17	25.00
Kairouan	63	57	43	77	49	40	9	22	22	13	3	19
	52.50	47.50	35.83	64.17	40.83	33.33	7.50	18.33	38.60	22.81	5.26	33.33
Sidi Bouzid	58	36	28	66	35	30	13	16	15	16	6	16
	61.70	38.30	29.79	70.21	37.23	31.91	13.83	17.02	28.30	30.19	11.32	30.19
Sud Est	65	71	101	35	51	62	14	9	21	28	8	10
	47.79	52.21	74.26	25.74	37.50	45.59	10.29	6.62	31.34	41.79	11.94	14.92
Sud Ouest	53	52	80	25	42	41	13	9	19	16	7	6
	50.48	49.52	76.19	23.81	40.00	39.05	12.38	8.57	39.58	33.33	14.58	12.50

**Table 12** Sample's characteristics by region (Health: 2011-2012). (Continued)

Tunisia 2012	Annual family incomes (Economic quintile)					Number of Children (2-14) at Home			Housing property			Waetr access: potable water	
	The poorest	second	medium	fourth	the richest	Less than 3	3 and mores	proprietor	location	Others	No access	access	
Région	288	230	179	221	141	914	145	738	194	127	489	570	
	27.20	21.72	16.90	20.87	13.31	86.31	13.69	69.69	18.32	11.99	46.18	53.82	
	6	19	26	37	47	131	4	57	53	25	40	95	
	4.44	14.07	19.26	27.41	34.81	97.04	2.96	42.22	39.26	18.52	29.63	70.37	
	24	36	29	34	23	140	6	107	25	14	62	84	
	16.44	24.66	19.86	23.29	15.75	95.89	4.11	73.29	17.12	9.59	42.47	57.53	
	40	27	21	15	9	99	13	84	17	11	44	68	
	35.71	24.11	18.75	13.39	8.04	88.39	2.68	75.00	15.18	9.82	39.29	60.71	
	14	18	19	32	26	98	11	75	29	5	45	64	
	12.84	16.51	17.43	29.36	23.85	89.91	10.09	68.81	26.61	4.59	41.28	58.72	
	39	37	13	11	2	83	19	60	13	29	37	65	
	38.24	36.27	12.75	10.78	1.96	81.37	18.63	58.82	12.75	28.43	36.27	63.73	
	71	21	12	13	3	92	28	97	9	14	72	48	
	59.17	17.50	10.00	10.83	2.50	76.67	23.24	80.83	7.50	11.67	60.00	40.00	
	47	20	11	11	5	73	21	76	10	8	62	32	
	50.00	21.28	11.70	11.70	5.32	77.66	22.34	80.85	10.64	8.51	65.96	34.04	
	22	33	29	41	11	115	21	101	19	16	87	49	
	16.18	24.26	21.32	30.15	8.09	84.56	15.44	74.26	13.97	11.77	63.97	36.03	
	25	19	19	27	15	83	22	81	19	5	40	65	
	23.81	18.10	18.10	25.71	14.29	79.05	20.95	77.14	18.10	4.76	38.10	61.90	

The second value in Tables 10, 11 and 12 Appendix correspond to the percentage contribution in the corresponding sample

**Table 13** Weight-for-age, and length –for –age, age in years and months

Year: month	Month	Z-scores (weight in kg)						Z-scores (length in cm)									
		Weight-for-age for boys			Weight-for-age for girls			Length –for –age for boys,			Length –for –age for girls						
		-3SD	-2SD	-1SD	Median	-3SD	-2SD	-1SD	Median	-3SD	-2SD	-1SD	Median				
0:0	0	2.1	2.5	2.9	3.3	2.0	2.4	2.8	3.2	44.2	46.1	48.0	49.9	43.6	45.4	47.3	49.1
0:1	1	2.9	3.4	3.9	4.5	2.7	3.2	3.6	4.2	48.9	50.8	52.8	54.7	47.8	49.8	51.7	53.7
0:2	2	3.8	4.3	4.9	5.6	3.4	3.9	4.5	5.1	52.4	54.4	56.4	58.4	51.0	53.0	55.0	57.1
0:3	3	4.4	5.0	5.7	6.4	4.0	4.5	5.2	5.8	55.3	57.3	59.4	61.4	53.5	55.6	57.7	59.8
0:4	4	4.9	5.6	6.2	7.0	4.4	5.0	5.7	6.4	57.6	59.7	61.8	63.9	55.6	57.8	59.9	62.1
0:5	5	5.3	6.0	6.7	7.5	4.8	5.4	6.1	6.9	59.6	61.7	63.8	65.9	57.4	59.6	61.8	64.0
0:6	6	5.7	6.4	7.1	7.9	5.1	5.7	6.5	7.3	61.2	63.3	65.5	67.6	58.9	61.2	63.5	65.7
0:7	7	5.9	6.7	7.4	8.3	5.3	6.0	6.8	7.6	62.7	64.8	67.0	69.2	60.3	62.7	65.0	67.3
0:8	8	6.2	6.9	7.7	8.6	5.6	6.3	7.0	7.9	64.0	66.2	68.4	70.6	61.7	64.0	66.4	68.7
0:9	9	6.4	7.1	8.0	8.9	5.8	6.5	7.3	8.2	65.2	67.5	69.7	72.0	62.9	65.3	67.7	70.1
0:10	10	6.6	7.4	8.2	9.2	5.9	6.7	7.5	8.5	66.4	68.7	71.0	73.3	64.1	66.5	69.0	71.5
0:11	11	6.8	7.6	8.4	9.4	6.1	6.9	7.7	8.7	67.6	69.9	72.2	74.5	65.2	67.7	70.3	72.8
1:0	12	6.9	7.7	8.6	9.6	6.3	7.0	7.9	8.9	68.6	71.0	73.4	75.7	66.3	68.9	71.4	74.0
1:1	13	7.1	7.9	8.8	9.9	6.4	7.2	8.1	9.2	69.6	72.1	74.5	76.9	67.3	70.0	72.6	75.2
1:2	14	7.2	8.1	9.0	10.1	6.6	7.4	8.3	9.4	70.6	73.1	75.6	78.0	68.3	71.0	73.7	76.4
1:3	15	7.4	8.3	9.2	10.3	6.7	7.6	8.5	9.6	71.6	74.1	76.6	79.1	69.3	72.0	74.8	77.5
1:4	16	7.5	8.4	9.4	10.5	6.9	7.7	8.7	9.8	72.5	75.0	77.6	80.2	70.2	73.0	75.8	78.6
1:5	17	7.7	8.6	9.6	10.7	7.0	7.9	8.9	10.0	73.3	76.0	78.6	81.2	71.1	74.0	76.8	79.7
1:6	18	7.8	8.8	9.8	10.9	7.2	8.1	9.1	10.2	74.2	76.9	79.6	82.3	72.0	74.9	77.8	80.7
1:7	19	8.0	8.9	10.0	11.1	7.3	8.2	9.2	10.4	75.0	77.7	80.5	83.2	72.8	75.8	78.8	81.7
1:8	20	8.1	9.1	10.1	11.3	7.5	8.4	9.4	10.6	75.8	78.6	81.4	84.2	73.7	76.7	79.7	82.7
1:9	21	8.2	9.2	10.3	11.5	7.6	8.6	9.6	10.9	76.5	79.4	82.3	85.1	74.5	77.5	80.6	83.7
1:10	22	8.4	9.4	10.5	11.8	7.8	8.7	9.8	11.1	77.2	80.2	83.1	86.0	75.2	78.4	81.5	84.6
1:11	23	8.5	9.5	10.7	12.0	7.9	8.9	10.0	11.3	78.0	81.0	83.9	86.9	76.0	79.2	82.3	85.5
2:0	24	8.6	9.7	10.8	12.2	8.1	9.0	10.2	11.5	78.0	81.0	84.1	87.1	76.0	79.3	82.5	85.7
2:1	25	8.8	9.8	11.0	12.4	8.2	9.2	10.3	11.7	78.6	81.7	84.9	88.0	76.8	80.0	83.3	86.6
2:2	26	8.9	10.0	11.2	12.5	8.4	9.4	10.5	11.9	79.3	82.5	85.6	88.8	77.5	80.8	84.1	87.4
2:3	27	9.0	10.1	11.3	12.7	8.5	9.5	10.7	12.1	79.9	83.1	86.4	89.6	78.1	81.5	84.9	88.3
2:4	28	9.1	10.2	11.5	12.9	8.6	9.7	10.9	12.3	80.5	83.8	87.1	90.4	78.8	82.2	85.7	89.1
2:5	29	9.2	10.4	11.7	13.1	8.8	9.8	11.1	12.5	81.1	84.5	87.8	91.2	79.5	82.9	86.4	89.9
2:6	30	9.4	10.5	11.8	13.3	8.9	10.0	11.2	12.7	81.7	85.1	88.5	91.9	80.1	83.6	87.1	90.7

**Table 13** Weight-for-age, and length –for –age, age in years and months (Continued)

2:7	31	9.5	10.7	12.0	13.5	9.0	10.1	11.4	12.9	82.3	85.7	89.2	92.7	80.7	84.3	87.9	91.4
2:8	32	9.6	10.8	12.1	13.7	9.1	10.3	11.6	13.1	82.8	86.4	89.9	93.4	81.3	84.9	88.6	92.2
2:9	33	9.7	10.9	12.3	13.8	9.3	10.4	11.7	13.3	83.4	86.9	90.5	94.1	81.9	85.6	89.3	92.9
2:10	34	9.8	11.0	12.4	14.0	9.4	10.5	11.9	13.5	83.9	87.5	91.1	94.8	82.5	86.2	89.9	93.6
2:11	35	9.9	11.2	12.6	14.2	9.5	10.7	12.0	13.7	84.4	88.1	91.8	95.4	83.1	86.8	90.6	94.4
3:0	36	10.0	11.3	12.7	14.3	9.6	10.8	12.2	13.9	85.0	88.7	92.4	96.1	83.6	87.4	91.2	95.1
3:1	37	10.1	11.4	12.9	14.5	9.7	10.9	12.4	14.0	85.5	89.2	93.0	96.7	84.2	88.0	91.9	95.7
3:2	38	10.2	11.5	13.0	14.7	9.8	11.1	12.5	14.2	86.0	89.8	93.6	97.4	84.7	88.6	92.5	96.4
3:3	39	10.3	11.6	13.1	14.8	9.9	11.2	12.7	14.4	86.5	90.3	94.2	98.0	85.3	89.2	93.1	97.1
3:4	40	10.4	11.8	13.3	15.0	10.1	11.3	12.8	14.6	87.0	90.9	94.7	98.6	85.8	89.8	93.8	97.7
3:5	41	10.5	11.9	13.4	15.2	10.2	11.5	13.0	14.8	87.5	91.4	95.3	99.2	86.3	90.4	94.4	98.4
3:6	42	10.6	12.0	13.6	15.3	10.3	11.6	13.1	15.0	88.0	91.9	95.9	99.9	86.8	90.9	95.0	99.0
3:7	43	10.7	12.1	13.7	15.5	10.4	11.7	13.3	15.2	88.4	92.4	96.4	100.4	87.4	91.5	95.6	99.7
3:8	44	10.8	12.2	13.8	15.7	10.5	11.8	13.4	15.3	88.9	93.0	97.0	101.0	87.9	92.0	96.2	100.3
3:9	45	10.9	12.4	14.0	15.8	10.6	12.0	13.6	15.5	89.4	93.5	97.5	101.6	88.4	92.5	96.7	100.9
3:10	46	11.0	12.5	14.1	16.0	10.7	12.1	13.7	15.7	89.8	94.0	98.1	102.2	88.9	93.1	97.3	101.5
3:11	47	11.1	12.6	14.3	16.2	10.8	12.2	13.9	15.9	90.3	94.4	98.6	102.8	89.3	93.6	97.9	102.1
4:0	48	11.2	12.7	14.4	16.3	10.9	12.3	14.0	16.1	90.7	94.9	99.1	103.3	89.8	94.1	98.4	102.7
4:1	49	11.3	12.8	14.5	16.5	11.0	12.4	14.2	16.3	91.2	95.4	99.7	103.9	90.3	94.6	99.0	103.3
4:2	50	11.4	12.9	14.7	16.7	11.1	12.6	14.3	16.4	91.6	95.9	100.2	104.4	90.7	95.1	99.5	103.9
4:3	51	11.5	13.1	14.8	16.8	11.2	12.7	14.5	16.6	92.1	96.4	100.7	105.0	91.2	95.6	100.1	104.5
4:4	52	11.6	13.2	15.0	17.0	11.3	12.8	14.6	16.8	92.5	96.9	101.2	105.6	91.7	96.1	100.6	105.0
4:5	53	11.7	13.3	15.1	17.2	11.4	12.9	14.8	17.0	93.0	97.4	101.7	106.1	92.1	96.6	101.1	105.6
4:6	54	11.8	13.4	15.2	17.3	11.5	13.0	14.9	17.2	93.4	97.8	102.3	106.7	92.6	97.1	101.6	106.2
4:7	55	11.9	13.5	15.4	17.5	11.6	13.2	15.1	17.3	93.9	98.3	102.8	107.2	93.0	97.6	102.2	106.7
4:8	56	12.0	13.6	15.5	17.7	11.7	13.3	15.2	17.5	94.3	98.8	103.3	107.8	93.4	98.1	102.7	107.3
4:9	57	12.1	13.7	15.6	17.8	11.8	13.4	15.3	17.7	94.7	99.3	103.8	108.3	93.9	98.5	103.2	107.8
4:10	58	12.2	13.8	15.8	18.0	11.9	13.5	15.5	17.9	95.2	99.7	104.3	108.9	94.3	99.0	103.7	108.4
4:11	59	12.3	14.0	15.9	18.2	12.0	13.6	15.6	18.0	95.6	100.2	104.8	109.4	94.7	99.5	104.2	108.9
5:12	60	12.4	14.1	16.0	18.3	12.1	13.7	15.8	18.2	96.1	100.7	105.3	110.0	95.2	99.9	104.7	109.4

**Table 14** Weight-for-length standards

Length (cm)	Z-scores (weight in kg)							
	Weight-for-length for boys				Weight-for-length for Girls			
	-3SD	-2SD	-1SD	Median	-3SD	-2SD	-1SD	Median
45.0	1.9	2.0	2.2	2.4	1.9	2.1	2.3	2.5
45.5	1.9	2.1	2.3	2.5	2.0	2.1	2.3	2.5
46.0	2.0	2.2	2.4	2.6	2.0	2.2	2.4	2.6
46.5	2.1	2.3	2.5	2.7	2.1	2.3	2.5	2.7
47.0	2.1	2.3	2.5	2.8	2.2	2.4	2.6	2.8
47.5	2.2	2.4	2.6	2.9	2.2	2.4	2.6	2.9
48.0	2.3	2.5	2.7	2.9	2.3	2.5	2.7	3.0
48.5	2.3	2.6	2.8	3.0	2.4	2.6	2.8	3.1
49.0	2.4	2.6	2.9	3.1	2.4	2.6	2.9	3.2
49.5	2.5	2.7	3.0	3.2	2.5	2.7	3.0	3.3
50.0	2.6	2.8	3.0	3.3	2.6	2.8	3.1	3.4
50.5	2.7	2.9	3.1	3.4	2.7	2.9	3.2	3.5
51.0	2.7	3.0	3.2	3.5	2.8	3.0	3.3	3.6
51.5	2.8	3.1	3.3	3.6	2.8	3.1	3.4	3.7
52.0	2.9	3.2	3.5	3.8	2.9	3.2	3.5	3.8
52.5	3.0	3.3	3.6	3.9	3.0	3.3	3.6	3.9
53.0	3.1	3.4	3.7	4.0	3.1	3.4	3.7	4.0
53.5	3.2	3.5	3.8	4.1	3.2	3.5	3.8	4.2
54.0	3.3	3.6	3.9	4.3	3.3	3.6	3.9	4.3
54.5	3.4	3.7	4.0	4.4	3.4	3.7	4.0	4.4
55.0	3.6	3.8	4.2	4.5	3.5	3.8	4.2	4.5
55.5	3.7	4.0	4.3	4.7	3.6	3.9	4.3	4.7
56.0	3.8	4.1	4.4	4.8	3.7	4.0	4.4	4.8
56.5	3.9	4.2	4.6	5.0	3.8	4.1	4.5	5.0
57.0	4.0	4.3	4.7	5.1	3.9	4.3	4.6	5.1
57.5	4.1	4.5	4.9	5.3	4.0	4.4	4.8	5.2
58.0	4.3	4.6	5.0	5.4	4.1	4.5	4.9	5.4
58.5	4.4	4.7	5.1	5.6	4.2	4.6	5.0	5.5
59.0	4.5	4.8	5.3	5.7	4.3	4.7	5.1	5.6
59.5	4.6	5.0	5.4	5.9	4.4	4.8	5.3	5.7
60.0	4.7	5.1	5.5	6.0	4.5	4.9	5.4	5.9
60.5	4.8	5.2	5.6	6.1	4.6	5.0	5.5	6.0
61.0	4.9	5.3	5.8	6.3	4.7	5.1	5.6	6.1
61.5	5.0	5.4	5.9	6.4	4.8	5.2	5.7	6.3
62.0	5.1	5.6	6.0	6.5	4.9	5.3	5.8	6.4
62.5	5.2	5.7	6.1	6.7	5.0	5.4	5.9	6.5
63.0	5.3	5.8	6.2	6.8	5.1	5.5	6.0	6.6
63.5	5.4	5.9	6.4	6.9	5.2	5.6	6.2	6.7
64.0	5.5	6.0	6.5	7.0	5.3	5.7	6.3	6.9
64.5	5.6	6.1	6.6	7.1	5.4	5.8	6.4	7.0
65.0	5.7	6.2	6.7	7.3	5.5	5.9	6.5	7.1
65.5	5.8	6.3	6.8	7.4	5.5	6.0	6.6	7.2

**Table 14** Weight-for-length standards (*Continued*)

66.0	5.9	6.4	6.9	7.5	5.6	6.1	6.7	7.3
66.5	6.0	6.5	7.0	7.6	5.7	6.2	6.8	7.4
67.0	6.1	6.6	7.1	7.7	5.8	6.3	6.9	7.5
67.5	6.2	6.7	7.2	7.9	5.9	6.4	7.0	7.6
68.0	6.3	6.8	7.3	8.0	6.0	6.5	7.1	7.7
68.5	6.4	6.9	7.5	8.1	6.1	6.6	7.2	7.9
69.0	6.5	7.0	7.6	8.2	6.1	6.7	7.3	8.0
69.5	6.6	7.1	7.7	8.3	6.2	6.8	7.4	8.1
70.0	6.6	7.2	7.8	8.4	6.3	6.9	7.5	8.2
70.5	6.7	7.3	7.9	8.5	6.4	6.9	7.6	8.3
71.0	6.8	7.4	8.0	8.6	6.5	7.0	7.7	8.4
71.5	6.9	7.5	8.1	8.8	6.5	7.1	7.7	8.5
72.0	7.0	7.6	8.2	8.9	6.6	7.2	7.8	8.6
72.5	7.1	7.6	8.3	9.0	6.7	7.3	7.9	8.7
73.0	7.2	7.7	8.4	9.1	6.8	7.4	8.0	8.8
73.5	7.2	7.8	8.5	9.2	6.9	7.4	8.1	8.9
74.0	7.3	7.9	8.6	9.3	6.9	7.5	8.2	9.0
74.5	7.4	8.0	8.7	9.4	7.0	7.6	8.3	9.1
75.0	7.5	8.1	8.8	9.5	7.1	7.7	8.4	9.1
75.5	7.6	8.2	8.8	9.6	7.1	7.8	8.5	9.2
76.0	7.6	8.3	8.9	9.7	7.2	7.8	8.5	9.3
76.5	7.7	8.3	9.0	9.8	7.3	7.9	8.6	9.4
77.0	7.8	8.4	9.1	9.9	7.4	8.0	8.7	9.5
77.5	7.9	8.5	9.2	10.0	7.4	8.1	8.8	9.6
78.0	7.9	8.6	9.3	10.1	7.5	8.2	8.9	9.7
78.5	8.0	8.7	9.4	10.2	7.6	8.2	9.0	9.8
79.0	8.1	8.7	9.5	10.3	7.7	8.3	9.1	9.9
79.5	8.2	8.8	9.5	10.4	7.7	8.4	9.1	10.0
80.0	8.2	8.9	9.6	10.4	7.8	8.5	9.2	10.1
80.5	8.3	9.0	9.7	10.5	7.9	8.6	9.3	10.2
81.0	8.4	9.1	9.8	10.6	8.0	8.7	9.4	10.3
81.5	8.5	9.1	9.9	10.7	8.1	8.8	9.5	10.4
82.0	8.5	9.2	10.0	10.8	8.1	8.8	9.6	10.5
82.5	8.6	9.3	10.1	10.9	8.2	8.9	9.7	10.6
83.0	8.7	9.4	10.2	11.0	8.3	9.0	9.8	10.7
83.5	8.8	9.5	10.3	11.2	8.4	9.1	9.9	10.9
84.0	8.9	9.6	10.4	11.3	8.5	9.2	10.1	11.0
84.5	9.0	9.7	10.5	11.4	8.6	9.3	10.2	11.1
85.0	9.1	9.8	10.6	11.5	8.7	9.4	10.3	11.2
85.5	9.2	9.9	10.7	11.6	8.8	9.5	10.4	11.3
86.0	9.3	10.0	10.8	11.7	8.9	9.7	10.5	11.5
86.5	9.4	10.1	11.0	11.9	9.0	9.8	10.6	11.6
87.0	9.5	10.2	11.1	12.0	9.1	9.9	10.7	11.7
87.5	9.6	10.4	11.2	12.1	9.2	10.0	10.9	11.8
88.0	9.7	10.5	11.3	12.2	9.3	10.1	11.0	12.0

**Table 14** Weight-for-length standards (*Continued*)

88.5	9.8	10.6	11.4	12.4	9.4	10.2	11.1	12.1
89.0	9.9	10.7	11.5	12.5	9.5	10.3	11.2	12.2
89.5	10.0	10.8	11.6	12.6	9.6	10.4	11.3	12.3
90.0	10.1	10.9	11.8	12.7	9.7	10.5	11.4	12.5
90.5	10.2	11.0	11.9	12.8	9.8	10.6	11.5	12.6
91.0	10.3	11.1	12.0	13.0	9.9	10.7	11.7	12.7
91.5	10.4	11.2	12.1	13.1	10.0	10.8	11.8	12.8
92.0	10.5	11.3	12.2	13.2	10.1	10.9	11.9	13.0
92.5	10.6	11.4	12.3	13.3	10.1	11.0	12.0	13.1
93.0	10.7	11.5	12.4	13.4	10.2	11.1	12.1	13.2
93.5	10.7	11.6	12.5	13.5	10.3	11.2	12.2	13.3
94.0	10.8	11.7	12.6	13.7	10.4	11.3	12.3	13.5
94.5	10.9	11.8	12.7	13.8	10.5	11.4	12.4	13.6
95.0	11.0	11.9	12.8	13.9	10.6	11.5	12.6	13.7
95.5	11.1	12.0	12.9	14.0	10.7	11.6	12.7	13.8
96.0	11.2	12.1	13.1	14.1	10.8	11.7	12.8	14.0
96.5	11.3	12.2	13.2	14.3	10.9	11.8	12.9	14.1
97.0	11.4	12.3	13.3	14.4	11.0	12.0	13.0	14.2
97.5	11.5	12.4	13.4	14.5	11.1	12.1	13.1	14.4
98.0	11.6	12.5	13.5	14.6	11.2	12.2	13.3	14.5
98.5	11.7	12.6	13.6	14.8	11.3	12.3	13.4	14.6
99.0	11.8	12.7	13.7	14.9	11.4	12.4	13.5	14.8
99.5	11.9	12.8	13.9	15.0	11.5	12.5	13.6	14.9
100.0	12.0	12.9	14.0	15.2	11.6	12.6	13.7	15.0
100.5	12.1	13.0	14.1	15.3	11.7	12.7	13.9	15.2
101.0	12.2	13.2	14.2	15.4	11.8	12.8	14.0	15.3
101.5	12.3	13.3	14.4	15.6	11.9	13.0	14.1	15.5
102.0	12.4	13.4	14.5	15.7	12.0	13.1	14.3	15.6
102.5	12.5	13.5	14.6	15.9	12.1	13.2	14.4	15.8
103.0	12.6	13.6	14.8	16.0	12.3	13.3	14.5	15.9
103.5	12.7	13.7	14.9	16.2	12.4	13.5	14.7	16.1
104.0	12.8	13.9	15.0	16.3	12.5	13.6	14.8	16.2
104.5	12.9	14.0	15.2	16.5	12.6	13.7	15.0	16.4
105.0	13.0	14.1	15.3	16.6	12.7	13.8	15.1	16.5
105.5	13.2	14.2	15.4	16.8	12.8	14.0	15.3	16.7
106.0	13.3	14.4	15.6	16.9	13.0	14.1	15.4	16.9
106.5	13.4	14.5	15.7	17.1	13.1	14.3	15.6	17.1
107.0	13.5	14.6	15.9	17.3	13.2	14.4	15.7	17.2
107.5	13.6	14.7	16.0	17.4	13.3	14.5	15.9	17.4
108.0	13.7	14.9	16.2	17.6	13.5	14.7	16.0	17.6
108.5	13.8	15.0	16.3	17.8	13.6	14.8	16.2	17.8
109.0	14.0	15.1	16.5	17.9	13.7	15.0	16.4	18.0
109.5	14.1	15.3	16.6	18.1	13.9	15.1	16.5	18.1
110.0	14.2	15.4	16.8	18.3	14.0	15.3	16.7	18.3

**Table 15** Prenatal care coverage Percentage distribution of women aged 15-49 who gave birth in the two years preceding the survey by antenatal care staff, Tunisia, 2011-2012

Tunisia 2011-2012		Doctor	Nurse/Midwife	Auxiliary midwife	Traditional accoucheuse	No prenatal care received	Any staff	
	Total	1059	837	18	471	1	23	1036
		100.00	79.03	1.69	44.47	0.09	2.17	97.83
Gender	Male	545	424	7	244	1	16	529
		51.46	77.65	1.28	44.77	0.18	2.94	97.06
	Female	514	413	11	227	0	7	507
		48.54	80.35	2.14	44.16	0.00	1.36	98.64
Residence	Urban	601	497	11	244	1	9	592
		56.75	82.69	1.83	40.59	0.16	1.50	98.50
	Rural	458	340	7	227	0	14	444
		43.25	74.23	1.52	49.56	0.00	3.06	96.94
Region	District Tunis	135	123	0	22	0	3	132
		12.75	91.11	0.00	16.29	0.00	2.22	97.78
	Nord Est	146	130	6	55	0	3	143
		13.79	89.04	4.10	37.67	0.00	2.05	97.95
	Nord Ouest	112	86	1	65	1	1	111
		10.58	76.78	0.89	58.03	0.89	0.89	99.11
	Centre Est	109	102	1	35	0	1	108
		10.29	93.57	0.91	32.11	0.00	0.92	99.08
	Kasserine	102	77	1	54	0	3	99
		9.63	75.49	0.98	52.94	0.00	2.94	97.06
	Kairouan	120	81	0	57	0	2	118
		11.33	67.50	0.00	47.50	0.00	1.67	98.33
	Sidi Bouzid	94	72	1	29	0	10	84
		8.88	76.59	1.06	30.85	0.00	10.64	89.36
	South East	136	94	3	79	0	0	136
		12.84	69.11	2.20	58.08	0.00	0.00	100.00
	South west	105	72	5	75	0	0	105
		9.92	68.57	4.76	71.42	0.00	0.00	100.00
Mather's education	Nothingness	88	59	0	42	1	2	84
		17.46	67.04	0.00	47.72	1.13	2.33	97.67
	Primary and similar	172	130	1	82	0	3	169
		34.13	75.58	0.58	47.67	0.00	1.74	98.26
	Secondary and similar	157	125	4	68	0	4	153
		31.15	79.61	2.54	43.31	0.00	2.55	97.45
	Superior	87	81	2	23	0	0	87
		17.26	93.10	2.29	27.38	0.00	0.00	100.00
	No reponse	555	442	11	256	0	12	543
		52.40	79.63	2.41	46.12	0.00	2.16	97.84
Annual family incomes (Economic quintile)	The poorest	288	171	3	151	1	15	273
		27.20	59.37	1.04	52.43	0.34	5.21	94.79
	Second	230	180	5	123	0	2	228
		21.72	78.26	2.17	53.47	0.00	0.87	99.13
	Medium	179	144	2	87	0	5	174
		16.90	80.44	1.11	48.60	0.00	2.79	97.21
	Fourth	221	204	5	80	0	1	220
		20.87	92.30	2.26	36.19	0.00	0.45	99.55
	The richest	141	138	3	30	0	0	141
		13.31	97.87	2.12	21.27	0.00	0.00	100.00

The second value in the table corresponds to the percentage contribution in the corresponding sample

**Table 16** Logit model regression by regions (Nutrition conditions)

2012	Nutrition: Weight for Age									
	District Tunis	Nord Est	N ord Ouest	Centre Est	Kasserine	Kairouan	Sidi Bouzid	South East	South west	Centre Est
Gender	x		x							
Residence										
H-H Education			x	x	x					x
Household income									x	
H-H gender										
Household size				x	x			x		x
Number of children (2-14)									x	
H-H age					x	x				x

  

2012	Nutrition: Weight for height									
	Kasserine	Kairouan	Sidi Bouzid	South East	South west	District Tunis	Nord Est	Nord Ouest	Centre Est	Kasserine
Regions										
Gender										
Residence										
H-H Education	x		x							x
Household income	x		x							
H-H gender										
Household size								x		
Number of children (2-14)									x	
H-H age		x								x

x indicates statistical significance at the 10% threshold level.



**Abbreviations**

HOI: Human opportunity index; INS: National institute of statistics; MICs: Multiple indicator cluster surveys; UNESCO: United Nations, Education, Scientific and Cultural Organization; UNFPA: United Nations population fund; UNICEF: United Nations Children's Emergency Fund; WHO: world Health Organization

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