Socioeconomic inequality in overweight in Sub Saharan Africa. Is it growing and why (not)?

Master thesis Health Economics (HEPL)
Name: Marijke Bos
Student number: 313848
Supervisor: Prof. Dr. E.K.A. van Doorslaer
Co-evaluators: I.E.J. Bonfrer MSc & Dr. E. van de Poel
Date: 27th of June 2013

Table of Contents

Foreword

This thesis has been written in completion of my master Health Economics (HEPL) at the Erasmus University of Rotterdam. Looking back on my master year I have gained different insights in the world of Health Economics and highly improved my analytic skills. The master has enhanced my interest for doing quantitative research on socioeconomic topics. Therefore I would like to continue my future career within this field of specialization.

As the topic of my master thesis concerns my main interest in Health Economics I really enjoyed working on it. However, I could not have brought it to this quality level without some important people. First of all, I would like to thank my supervisor, Eddy van Doorslaer, for supporting me during the thesis process and for sharing interesting insights and ideas concerning my thesis topic. Also I would like to acknowledge Igna Bonfrer and Ellen van de Poel for being co-evaluators of my thesis and for helping me out with running some important Stata commands. Besides, I would also like to thank Leander Buisman for helping with merging the datasets.

Finally, I would like to give special thanks to my parents who unconditionally supported me during my study. Without them I would not have been able to accomplish this study.

Abstract

Objective

Rationale for this study is the worldwide obesity epidemic, increasingly affecting the low income world. Also Sub Saharan Africa is nowadays confronted with a rising prevalence of overweight. The aim of this study was to investigate and explain the socioeconomic gradient in overweight in Sub Saharan Africa.

Methods

Datasets were derived from Demographic Health Surveys (DHS) carried out by the National Demographic Health program. To explore a recent time trend in the prevalence of overweight in Sub Saharan African countries, it has been decided to include data generated between 2004 and 2011. Countries included are Rwanda, Uganda, Senegal, Zimbabwe, Lesotho, Ethiopia and Malawi. The dataset contains a sample size of 39770 females. The primary outcome is overweight measured by the body mass index (BMI>25). The Erreygers corrected concentration index (CC) will be used to measure the absolute wealth related inequality in overweight. The inequalities in overweight are explained by a decomposition analysis. As the study aims to explain the trend in wealth related inequality in overweight, the change in the CCs has also been decomposed.

Results

Apart from Senegal and Lesotho, all countries experienced a positive trend in the prevalence of overweight. Lesotho, Zimbabwe and Senegal show the highest percentages of overweight. Overweight appears to be most concentrated among the most wealthy groups in all countries during both periods. Countries with the lowest Gross Domestic Product (GDP) show a positive trend in overweight inequality. Contrary, a negative trend is observable in more developed countries. The most important explanatory factors of inequality are respectively wealth, urbanization and education. The degree in which these factor contribute to the change in overweight inequality differs by country. However, education seems to become more important with a higher stage of economic development.

Conclusion

As overweight in Sub Saharan Africa is nowadays mostly concentrated among the rich it could be questioned whether the current socioeconomic distribution of overweight is a major problem for health policy makers. However it might be assumed that the socioeconomic distribution of overweight will shift towards the poor in the future. Wealth, urbanization and education should be taken into consideration as important contributors to the socioeconomic inequality in overweight. Understanding the socioeconomic gradient in overweight will guide policymakers in addressing this problem in Sub Saharan Africa.

Introduction

At the end of the previous century, the World Health Organization (WHO) officially proclaimed obesity as being a global epidemic (WHO 2000:16). Even low income countries did not remain unscathed by the obesity epidemic, which makes their population nowadays increasingly at risk to develop also non communicable diseases (NCDs) (Prentice 2006:93; Abubakari et al 2008:297; Mendez et al. 2005:714) Overweight is a major risk factor for the development of NCDs like diabetes mellitus type 2, cardiovascular disease, hypertension, osteoarthritis, stroke and certain cancers (Jones-Smith et al. 2011:667; Abubakari et al 2008:298; Ziraba et al. 2009; Monteiro et al. 2004:1185,1186). Monteiro et al. (2004) even calls obesity a disease in its own right. The higher burden of NCDs may eventually lead to a decreasing quality of life or might even become fatal (Ziraba et al. 2008; Monteiro et al. 2004:1185,1186). Sixty-six percent of the cause-specific mortality related to NCDs emerges in low-income countries, which do not have high quality of health services and which' populations are often not able to afford treatment and care (Prentice 2006:98). As a result, populations in low income countries are more likely to develop complications of chronic diseases and are dying from NCDs at a lower average age than populations in more developed countries (Prentice 2006:98; Ziraba et al. 2009:2). Since the developing world simultaneously tries to counter the continuous threat of childhood malnutrition and communicable diseases like Malaria, Tuberculosis and AIDS/HIV, they are confronted with a so-called 'Double Burden of Disease' (Abubakari et al 2008:298; Mendez et al. 2005:714; Prentice 2006:98). A mixed epidemic of these diseases results in increased pressure on existing health services in low income countries, in which conditions are already fragile (Prentice 2006:98). To date, the focus of investments and research has been on communicable diseases, ignoring the transition of developing countries towards NCDs, partially caused by overweight (Prentice 2006:93). Therefore the WHO has called for action to prevent a further increase in the prevalence of overweight in the future (Abubakari et al 2008:297; Prentice 2006:93).

The rising prevalence of overweight in developing countries is the result of economic development, stimulating industrialization and urbanization. In turn this leads to the adoption of a more westernized lifestyle. On the one hand the intake of fat, sugar, edible oil and animal-source food increases and the energy density of diets grow (Popkin et al. 2012). On the other hand the energy consumption decreases by the substitution of labour intensive occupations for less labour demanding occupations, a lower intensity of housekeeping and an increase of sedentary leisure time (Abubakari et al. 2008; Prentice 2006:96; Popkin et al. 2012).

Although being the least urbanized continent in the world, Africa increasingly experiences an urban transition (Cohen 2004). Consequently an increased prevalence of overweight can be detected within African countries (Ziraba et al. 2009:2). As the rise in the prevalence of overweight in Africa becomes higher in time, the prevalence rates within this continent are quickly outdated (Prentice 2006:93). Several studies were carried out to investigate the increasing prevalence in overweight in African countries (Ziraba et al. 2009; Sodjinou et al. 2008; Biritwum 2005; Bourne 2002; Sobngwi et

al. 2004) However, the prevalence rates alternate per African country, which reflects a different level in country-specific economic development (Prentice 2006:94). It depends on the economic development stage of a country whether overweight is more concentrated among the rich or poor of a society, resulting in a wealth related inequality in overweight (Tafreschi 2012:8). Regarding the different levels of economic development across African countries this raises the questions whether different wealth related inequalities in overweight exists across African countries. Some studies imply the existence of socioeconomic inequalities in overweight by suggesting that overweight in African countries is most concentrated among the rich (Ziraba et al 2009; Fezeu et al. 2006; Amoah 2003; Sodjinou et al. 2008). Yet none of these studies quantifies the magnitude of this socioeconomic inequality.

Subsequently, it has been investigated that the socioeconomic distribution of overweight changes by a continuing economic development (Tafreschi 2012:8). Starting from overweight being most concentrated among the most wealthy population groups a shift might occur in time towards the lower wealth groups (Jones-Smith et al. 2011; Hruschka & Brewis 2012:7). Consequently, this will lead to changes in socioeconomic related inequalities in health within African countries (Popkin et al. 2012:2). Apart from the empirical evidence on the existing shift in the prevalence of overweight from high to low socioeconomic groups in low income countries, there is no evidence yet to confirm or refute a country-specific phenomenon in Africa. The studies of Jones-Smith et al. (2011) and Hruschka & Brewis (2012) do not quantify or explain the change in socioeconomic inequality in overweight in low income countries by a decomposition analysis. The literature suggests that urbanization and economic development are contributing factors for the increasing prevalence in overweight in developing countries, but do the factors also contribute to a change in the socioeconomic gradient of overweight?

This study aims to address the questions described above. The purpose of study is to investigate and explain the trend in wealth related inequality in overweight in Sub Saharan Africa. Reason to focus on Sub Saharan Africa is the increasing prevalence in overweight together with the continuing economic development driving urbanization in Sub Saharan African countries. Additionally, it is expected that Sub Saharan countries are most comparable in terms of economic development, ethnicity and cultural factors. Therefore the following research question and related sub questions are composed;

What is the socioeconomic related inequality in overweight in Sub Saharan African countries over time and how can the trend be explained?

Sub questions:

1. Does the prevalence of overweight within Sub Saharan African countries differ by gender, region and wealth?
2. Is a rising trend in overweight observable in Sub Saharan Africa from 2004/2006 till 2010/2011?
3. Does a socioeconomic related inequality in overweight exists in 2004/2006 and 2010/2011?
4. How does the socioeconomic related inequality in overweight elapse between the two periods?
5. How might the trends in the socioeconomic related inequality of overweight be explained?

Background

Overweight develops by the surplus of calorie-intake and at the same time a deficiency of calorie expenditure. These changes in dietary patterns and physical activity are a consequence of technological innovation driven by economic development (Lakdawalla & Philipson 2002:2). Philipson & Posner (2003) theoretically explain overweight at the micro level by the interaction between 1) the relative price of food, 2) individual income and 3) calorie expenditure during work. All of these factors depend on a country's level of economic development. The relative price of food decreases with economic development due to technological innovation which allows for a more efficient food production. Additionally, economic development leads to an increase in the productivity, which raises individual income. A decrease in the relative food prices as well as an increase in individual income results in an increased consumption of calories. On the other side, technological innovation is associated with a substitution of labor intensive occupations for more sedentary jobs, leading to a decrease in calorie expenditure. Eventually, the increase in calorie consumption combined with a decrease in calorie expenditure, results in higher weight.

Nevertheless, Philipson & Posner (2003) argue that the increase in overweight is self-limiting. The marginal utility derived from gaining more weight decreases at a certain point. At this point an individual reaches his optimum weight. Therefore they model the relationship between a country's economic development and weight gain of the population in a so-called inverted U-shape. The inverted U-shape explains the socioeconomic gradient in overweight by the non-monotonic effect of weight on utility. Individuals with low weight levels in less developed countries derive increased utility from gaining weight, because it leads to a better health state. An increase in income associated with economic development enables these individuals to gain weight, which results in weight being positively related to income. However up till a certain point where an individual surpasses his optimum weight, more utility will be derived from losing weight to get a better health status. At this point, overweight will be negatively related to income. A trend which is observable in more technically advanced countries (Philipson & Posner 2003:90).

Thus people value weight differently depending on their income, which is associated with a country's level of economic development. Developing countries show a positive socioeconomic gradient in overweight (Ziraba et al 2009; Fezeu 2006; Amoah 2003; Sodjinou et al. 2008; Jones-Smith et al. 2011; Hruschka & Brewis 2012:7). This means that an increase in income is associated with an increase in individuals' weight, because people derive utility from gaining weight. Some studies have found empirical evidence for the increased utility derived from gaining weight in African countries (Abubakari et al. 2008; Monteiro et al. 2004:1185; Abdulai 2010: 167). These studies argue that overweight in African countries partly results from their populations' cultural perceptions regarding overweight. Having a fat body size is highly valued, because it indicates a good, happy and healthy life (Abubakari et al. 2008) (Monteiro et al. 2004:1185). Moreover, it is one of the beauty-indicators for women (Abubakari et al. 2008). This can be explained by the perspective of the African population on

thinness, because the image of being thin is associated with poverty, malnutrition, AIDS and alcoholism (Abdulai 2010: 167). Whether this value for weight gain might change in the future when a reverse socioeconomic gradient is expected is questionable. According to the theory of Philipson & Posner (2003) this will be the case, because a weight gain is decreasingly valued when the optimum weight is reached and a country continues to develop.

However the theory of Philipson & Posner (2003) shows the socioeconomic gradient in overweight at the aggregate country level. The presence of overweight at the individual level cannot be explained by aggregate data, because of the non-linear relationship between overweight and income (Tafreschi 2012:7). This concerns the aggregation problem as discussed in Wildman (2001:357). Yet it has been investigated whether the socioeconomic distribution of overweight also changes with economic development in low income countries. Results showed that the distribution of overweight appeared to shift from the rich to the poor in countries with continuing economic development (Tafreschi 2012:10).

The distribution of overweight being related to economic development raises questions about the current distribution of overweight within developing countries. Empirical evidence shows that overweight in low income countries is most concentrated among the higher wealth groups, favouring the poor (Monteiro et al. 2004:1182) (Hosseinpoor et al. 2012:9) (Mendez 2005:720) (Abdulai 2010:167) (Ziraba et al. 2009:6). Monteiro et al. (2004:1182) specifies that overweight appears to be most concentrated among the highest wealth groups in countries with a GDP below 745 US dollars per capita and most concentrated among the lowest wealth groups in countries with a GDP above 2995 US dollars. Also earlier studies carried out between 1933 and 1996 revealed similar results (Monteiro et al. (2004:1182). Empirical evidence from developing countries shows that the socioeconomic inequality in overweight concentrated among the rich can be explained by a limited ability of the poor to obtain food and a discrepancy in the level of physical activity between the rich and poor. Less physical activity among the rich is caused by a decrease in labor intensive work and an increase in leisure time for the more wealthy population groups (Hosseinpoor et al. 2012:9) (Monteiro et al. 2004:1185). These results are in line with the previously described theory of Philipson and Posner (2003), explaining overweight by an increased energy intake and decreased physical activity.

Also Sub Saharan African countries show overweight being most concentrated among the most wealthy population groups (Ziraba et al. 2009:6). It would be interesting to see whether this distribution corresponds with the countries' level of GDP per capita. The GDP per capita of countries selected in this study is shown in the table below. Apart from Senegal, the countries' GDP per capita in 2004-2006 does not exceed 745 US dollars, which might imply that overweight is most concentrated among the rich in these countries (Monteiro et al. 2004:1182). Additionally, the countries show an increase in GDP per capita over time which means that the countries' economies have developed. The question is whether a change in the socioeconomic distribution of overweight might occur as a consequence of the economic development.

	GDP per capita (current US$)			
Country	**Period 1**		**Period 2**	
	GDP	**Year**	**GDP**	**Year**
Rwanda	281	2005	529	2010
Uganda	340	2006	487	2011
Senegal	800	2005	1119	2011
Zimbabwe	434	2006	757	2011
Lesotho	603	2004	796	2009
Ethiopia	165	2005	357	2011
Malawi	210	2004	365	2011

Table 1 Countries' GDP per capita (in US dollars), by period (Worldbank 2013b)

Apart from economic development, the wealth related inequality in overweight might also be explained by urbanization. Urban residents in developing countries are more likely to be overweight than their rural counterparts (Abubakari et al. 2008:306) (Popkin et al. 2012:3) (Mendez et al 2005:716) (Ziraba et al. 2009:2). Approximately twenty till fifty percent of the African urban population is considered to be overweight. This number is expected to increase even further with respect to the continuing urbanization in Africa. A large share of the urban population consists of rich people. The adoption of an urban lifestyle by the wealthiest population groups might explain the concentration of wealth related inequality in overweight among the rich. However, a large share of the new urban population will exist of poor people, experiencing restricted access to social facilities and purchasing cheap unhealthy food containing high levels of sugar and fat. Together with a lack of health knowledge and resources among the urban poor, resulting in limited opportunities to adopt a healthier lifestyle, this might lead to a shift in the concentration of overweight towards the lower wealth groups in urban areas (Ziraba et al. 2009:2). However, evidence shows that the relative annual change in overweight prevalence for rural women is higher. This implies that the discrepancy in BMI between rural and urban women becomes smaller (Popkin et al. 2012:3). Mendez et al. (2005:716) has found a positive link between the level of urbanization and overweight in urban as well as rural areas (Mendez et al. 2005:717). A possible explanation is the economic development of rural areas being pulled by urbanization, which provides an improvement of infrastructure and facilities. This might allow rural residents to adopt an urban lifestyle (Mendez et al. 2005:719). It could also be explained by urban residents sending money to their rural counterparts, leading to a change in food demand in rural areas (Prentice 2006:96).

Methods

In this study an econometric analysis was conducted to investigate the socioeconomic related inequality in overweight in Sub Saharan Africa.

3.1 Data

Datasets were derived from Demographic Health Surveys (DHS) carried out by the National Demographic Health program. This program is worldwide recognized as an important contributor to the collection and dissemination of national representative data on population health. The program is established and supported by the United States Agency for International Development. The National Demographic Health program collects data by different types of surveys. These surveys use standard questionnaires in order to allow comparison across countries. The main survey is the Demographic Health Survey (DHS), which generates population-based data and consists of two types of questionnaires; the household questionnaire and the individual questionnaire. The latter differs by gender. The questionnaires are modified in every survey phase, which means that variables might be dropped or added to a new version of the questionnaires. Every variable has a unique name, which allows comparison of remaining variables over time (Measure DHS 2013a). Data generated by the DHS is publicly available and can be obtained by downloading relevant datasets from the website.[1]

Reason for using data derived from Demographic Health Surveys, which was initially developed to collect microdata on maternal and child health, is the coverage, comparability and quality of the data (Vaessen 1996). The survey is carried out every five year within each country. This makes it possible to explore time trends in population health. Nowadays, the survey provides micro data on fertility, family planning, maternal and child health, gender, HIV/AIDS, malaria and nutrition (Measure DHS 2013b) It has also widen its target group by including male respondents in the latest version, version six. Eligible participants are women aged between 15 and 54 and men aged between 15 and 54 (59)[2] (Boerma & Sommerfelt 1993).

To explore a recent time trend in the prevalence of overweight in Sub Saharan African countries, It has been decided to include those Sub Saharan African countries for which data was generated by the two most recent versions of DHS (version V and VI). These data contain information on anthropometric measures and include a timeframe of approximately five years. Additionally, version VI of DHS also provides information on anthropometric measures for men. Countries meeting these criteria and included in this study are Rwanda, Uganda, Senegal, Zimbabwe, Lesotho, Ethiopia and Malawi. Within these countries, the fifth version was implemented between 2004 and 2006 and the sixth version between 2009 and 2011. The exact year of implementation of both surveys per country is shown in table 2.

[1] Website available by: http://www.measuredhs.com

[2] The maximum age of males differs by survey

The analysis of the socioeconomic gradient in overweight requires also some micro data on demographic and socioeconomic characteristics. The household questionnaire only provides limited data on demographic and socioeconomic characteristics. For example, the household questionnaire does not provide data on parity and an individual's working status. Therefore, more comprehensive data is obtained by including data derived from individual questionnaires. This was achieved by merging the household data and individual data in Stata.

3.2 Study population

The age of the females and males included in this study respectively range between 20-49 years and 20-54 (59) years. Females and males aged below 20 were excluded from the study, since their stature might not yet meet the criteria for adult sizes (Creswell 2012: 1326; Cole 2007:6). Secondly, the time trend analysis on overweight will include an additional number of 39770 females whose height and weight has been listed in the first survey. Women being pregnant during their participation in the survey were excluded from the study to avoid invalid weight estimates. Sample sizes per country are listed in table 2.

Country	Period 1		Period 2	
	Year	Sample size	Year	Sample size
Senegal	2005	3,934	2010	5,051
Zimbabwe	2005	1,860	2010	2,092
Uganda	2006	2,800	2011	4,773
Rwanda	2005	5,263	2010	7,223
Malawi	2004	2,434	2010	2,828
Lesotho	2004	4,112	2010	12,652
Ethiopia	2005	8,435	2011	5,151
Total		28,838		39,770

Table 2 Year of implementation and sample sizes per survey

3.3 Dependent variable

The primary outcome will be overweight measured by the body mass index (BMI), which is defined as the weight in kilograms divided by the square of height in metres. According to Abubakari et al (2008:298) BMI is a common tool to measure the relative body fatness in clinical as well as epidemiological research. The interviewer's manual of the Demographic Health Survey from 2006 describes the way in which weight and height of each respondent is measured. Weight is measured by a solar-powered scale and height is measured in millimetres by an adjustable board (Neuman et al. 2011:1353). In line with the internationally standardized BMI cut offs, BMI will be transformed into the binary variable overweight with the categories "overweight" (BMI>25) and "not overweight"(BMI<25)

(Cole 2007:4; O'Donnell et al. 2008:43). Herewith we are able to examine the prevalence of overweight.

3.4 Independent variables

For each country a concentration index is constructed to measure the degree of wealth related inequality in females 'overweight per country. Moreover, the concentration indices are decomposed into contribution of demographic and socioeconomic factors to wealth related inequality in overweight. For the decomposition analysis per country, the following demographic and socioeconomic factors are used with corresponding categories in parentheses; age (20-24; 25-29; 30-34; 35-39; ≥40), marital status (not married; married; other), parity (no children; 1-2; 3-4; ≥5 children), working status (not working; working), education (no education; primary education; secondary education or higher) and household wealth (poorest; poor; middle; rich; richest) (Ziraba et al. 2009:2). Like Cresswell (2012:1327) and Monteiro et al. (2004:882), I also included living area (rural; urban) as an independent variable. To be able to interpret the contribution of each category to the wealth related inequality in overweight, I finally transformed the categories into dummies, using the first categories as the reference groups. To note, the individual dataset of Senegal in 2005 did not merge with the household dataset due to non-identical observations. Therefore I could only use the household dataset for Senegal's decomposition analysis, whereby the variable working status was deleted from the analysis. Alternatively, for the variable parity I used the number of children under five instead of the total number of children. Finally, marital status was omitted from the Senegal's decomposition analysis, because the variable did not contain observations for Senegal in 2005.

Due to a lack of data on income in DHS surveys, the wealth index is used as an indicator for the economic status of individuals. The wealth index indicates the relative wealth of a female compared to the other females included in the country's sample. The index indicates the living standard of a female's household, which is composed by the assets a household possesses, the construction materials of the household's accommodation and the extent to which the household has access to sanitation and water facilities (USAID 2009). Technically the wealth index is constructed by multiplying the calculated z-scores per indicator with the factor loading of the indicator and subsequently adding the indicator values up to a total wealth index. Then weights are assigned to every wealth indicator using a principal component analysis.

Additionally, the distribution of the household population is divided into quintiles according to a household's wealth index. This enables the categorization of the population by wealth. The distribution of the household population is weighted by multiplying the number of household members with the household's sample weight. The lowest 20% represent the country's poorest individuals and the highest 20% represent the country's richest individuals. The average wealth level of every quintile differs by country. This makes comparison of the wealth index between countries impossible (Smits & Steendijk 2012:2)

3.5 Analysis

First, a descriptive analysis is carried out to explore the data and investigate the prevalence of overweight in seven Sub Saharan African countries during the most recent period. Prevalence rates are distinguished by gender, living area (urban/rural) and country to see in which population segments overweight is most concentrated. It has also been examined whether there are differences in females' mean BMI between countries. Finally, the wealth related inequality in overweight is visualized by showing the prevalence of overweight per wealth group in each country.

3.5.1 Measurement of the inequality

Concentration indices are computed to investigate the degree of wealth related inequality in overweight per Sub Saharan African country over time (i.e. during period 1 and 2). The concentration index indicates the socioeconomic related inequality in a health variable. The concentration index is derived from the concentration curve, which shows the cumulative percentage of health against the cumulative percentage of households ranked by a socioeconomic indicator (Kakwani et al. 1997). The concentration index can be computed by multiplying the area between the concentration curve and the equality line (45 degree line) by two (O'Donnell et al. 2008:95). The original concentration index is derived from the Gini-coefficient, which requires the health variable to range on a similar ratio-scale as income (Erreygers 2009). However, overweight is a discrete variable which is bounded between the values 0 and 1 and ranges on an ordinal scale. Yet, to allow for the construction of a concentration index, 0 (not overweight) and 1 (overweight) should be interpreted as absolute terms (Kjellson & Gerdtham 2011:7). Subsequently the sum of zeroes and ones can be seen as the cumulative share of overweight and non-overweight individuals per cumulative wealth group in the population. Finally, the presence of overweight can be measured on a cardinal scale by calculating the mean prevalence per wealth group, which ranges between 0 and 1 (Erreygers & van Ourti, 2010).

3.5.1.1 Absolute and relative inequality

Inequality in unbounded ratio-scaled variables can be measured in absolute terms as well as in relative terms, dependent on the value judgments (Kjellson & Gerdtham 2011:8). Contrary, inequality in binary variables like health and ill health can only be measured absolutely to satisfy the mirror condition. As ill-health mirrors health, the degree of inequality in both variables should also mirror each other. Where a certain amount of health is concentrated among the rich, the same amount of ill-health should be concentrated among the poor. However, this is not the case when health and ill-health have a different distribution of health and ill-health. Health and ill-health having a different mean does not point their concentration indices in an opposite direction and does not give the concentration indices of the variables an equal size. To enable mirroring concentration indices for health and ill-health the mirror condition should be satisfied. This can only be achieved when the concentration index measures absolute inequality in health and ill-health. Hence the original

concentration index, measuring relative inequality in a variable, should be normalized (Erreygers 2009:507).

Three alternative rank dependent concentration indices, which satisfy the mirror condition are the generalized concentration index (V), the concentration index composed by Wagstaff (W) and the concentration index composed by Erryegers (E) (Erreygers 2009:508,510). However, the generalized concentration index (V) does not take into account cardinality. When assuming overweight to be a binary variable and assigning the value 1 to overweight when BMI>25 and assigning 0 when BMI<25, the variable can range on a ratio-scale by summing up the zeros and ones and expressing the prevalence in terms of μ. In this case, V will not be an accurate concentration index to measure the absolute inequality in overweight Erreygers (2009:509). Both E and W do take into account cardinality and at the same time satisfy the mirror condition. Only E dominates W by including level independence which implies monotonicity. Monotonicity means that a pro poor change in health should result in a pro poor change in the concentration index and a pro rich change in health should lead to a pro rich change in the concentration index (Erreygers 2009:510). W does not fulfill this property by which it might react counterintuitive or artificial to individual changes in health (Erreygers 2009:508). This results from the different denominators of E and W. Where the denominator of E is constant and invariant to μ, E is only sensitive to the socioeconomic rank of an individual changing health. Contrary, the denominator of W depends on the previous μ (i.e. the inital prevalence of health) and the previous absolute inequality in health. Consequently, a pro rich change in health does not necessarily lead to a pro rich change in the concentration index (Kjellsson & Gerdtham 2011:16).

3.5.1.2 The Erreygers concentration index

This study exclusively focuses on the absolute wealth related inequality in overweight. We assume monotonicity which means that an increased prevalence of overweight in the upper half of the wealth distribution will increase the wealth related inequality in overweight (Kjellsson & Gerdtham 2011:15). Hereby focusing solely on the change in overweight related to socioeconomic rank (Gerdtham et al. 2011:16). Accordingly, the Erreygers concentration index is used, which gives intuitive results for the wealth related inequality in overweight per country. Henceforth, the Erreygers concentration index will be discussed as the so-called 'corrected concentration index' (CC). The formula of the CC is as follows:

$$CC\ (y) = \frac{8}{n^2\ (b_h - a_{h)}} \sum_{i=1}^{n} \quad z_i y_i$$

(Erreygers 2009:511)

Where n is the number of individuals within the sample, a_h and b_h are the minimum and maximum of overweight, z_i is $\frac{n+1}{2} - \lambda$, where λ is the wealth related rank of the individual of which' value ranges

from 1 representing the richest to λ=n for the poorest. Finally, y_i represents the presence of overweight.

Related to the original concentration index, which' formula is written below;

$$C\ (y) = \frac{2}{N\mu}\sum_{i=1}^{n} \quad y_i r_i - 1 - \frac{1}{N},$$

(O'Donnell et al 2008:96)

the formula of the Erreygers concentration index can be written as a function of the original concentration index (C (h)):

$$CC(y) = 4\frac{\mu}{b_y - a_y}C(y)$$

Where μ is the mean of overweight and a_y and b_y are the minimum and maximum of overweight (Worldbank 2013a). In this study the Erreygers concentration index of overweight will be calculated based on C(y) as written by the latter formula. Furthermore, the minimum and maximum of overweight in this study are equal to respectively 0 and 1, which means that the μ will be divided by 1. Therefore the formula can also be computed by multiplying μ with four times the C(y).

3.5.1.3 Sample weights

When computing the corrected concentration index per period for each country, I applied the DHS-specific household sample weight. Reason for the application of household sample weights is to adjust for the unequal probability different households were selected in the sample. Herewith preventing over- or underrepresentation of particular subgroups in the sample and correcting for a possible variation in response rates (Rutstein & Rojas 2006:12). For an explanation of the construction of the household sample weight I refer to Rutstein and Rojas (2006:13), who developed a guide for DHS statistics in which they provide a detailed description of the construction of different sample weights.

3.5.2 Decomposition of the inequality

After having constructed the CCs for each country and period, the wealth related inequalities in overweight will be explained by a decomposition analysis. The decomposition analysis reveals the contribution of each individual factor to the wealth related inequality in overweight. The factor-specific contribution is composed by the sensitivity of overweight to the factor and the level of wealth related inequality in the factor itself (O'Donnell 2008:159).

The formula for the decomposition of CC can be written as follows (Van de Poel et al. 2012:686):

:

$$CC_y = 4\left[\sum_{j=1}^{J}\beta_j^P\bar{x}_j C_{x_j} + \sum_{k=1}^{K}\gamma_k^P\bar{z}_k C_{z_k} + \sum_{g=2}^{G}\delta_g^P\bar{D}_g C_{D_g} + GC_\varepsilon\right]$$

Where CC_y is the corrected concentration index, j represents a vector of a set of variables x_j. β_j is the coefficient for the factor j , x_j is the mean of the factor j and C_{xj} is the concentration index of the set of variables xj. K represents a vector of a set of variables z_k. $Y^p{}_k$ is the coefficient for the factor k, z is the mean of the factor k and C_{zk} is the concentration index of the set of variables zk. G represents a vector of a set of variables D_g. $\delta^p{}_g$ is the coefficient for the factor g, D_g is the mean of the factor g and C_{Dg} is the concentration index of the set of variables Dg. Finally, the last term is the generalized concentration index of the error term, the residual. The residual shows the share of wealth related inequality in overweight which cannot be explained by a wealth-related change in the explanatory factors (O'Donnell et al. 2008:159). Overweight is modeled by an ordinary least square regression (OLS) using a linear probability model.

3.5.3 Decomposition of change in the inequality

As the aim of this study is to explain the trend in wealth related inequality in overweight, the change in the corrected concentration indices of each country is decomposed to see whether the change in wealth related inequality in overweight can be explained by a change in the contributions of the explanatory factors. The change in the wealth related inequality in overweight with respect to the explanatory factors can be decomposed into the variation due to a change in the coefficient of the explanatory factors or to a change in the inequality in the explanatory factors. As shown in the formula below, the Oaxaca decomposition separates the diverse effects of variation in the factor-specific concentration indices and the coefficients on the overall change in the wealth related inequality in overweight.

$$\Delta CC = \sum_k \quad \beta_{kt}\,(CC_{kt} - CC_{kt-1}) + \sum_k \quad CC_{kt-1}\,(\beta_{kt} - \beta_{kt-1}) + \Delta\, GC\,(\varepsilon t)/\mu$$

The formula above is derived from the formula of O'Donnell et al. (2008:161), who wrote the formula for the original concentration index. Whereas the absolute inequality in overweight is measured, the formula differs from O'Donnell's formula by not decomposing the variation in overweight inequality due to a change in the variables' elasticities, but due to a change in the variables' coefficients. A

change in wealth-related inequality in overweight occurs due to a change in the factor-specific concentration indices or due to a change in the coefficients of the factors. The differences in the factor-specific concentration indices over time are weighted by the coefficient of the factor in period 2 and the variation in the coefficients of the factor are weighted by the factor-specific concentration index in period 1. It should be noted that the Oaxaca decomposition is not unique and can alternatively be done by respectively weighing the change in the factor-specific concentration indices and coefficients against the coefficient and concentration index of the other period.

Results

4.1 Descriptive analysis

Overweight is distributed differently across gender. To see whether overweight in Sub Saharan Africa is most concentrated among men or women, the analysis starts with explaining the gender differences in overweight. Since data on anthropometric measures like BMI have only recently become available for men in the latest DHS survey (DHS VI 2010-2011), the is conducted for the countries in which these surveys are carried out.

Figure 1 indicates that overall overweight is mostly concentrated among women. Less than 10% of the male respondents in all countries are overweight. Compared to the female respondents, this is only a small percentage. Lesotho has the highest prevalence. Forty percent of the females in this country are living with overweight or obesity. Zimbabwe has the second highest prevalence of overweight (28%) of the countries compared. Rwanda, Uganda and Senegal belong to the middle class with 16-18% of females being overweight/obese , whereas in Ethiopia only 7% is overweight. From these results it might be derived that the problem of overweight in Sub Saharan Africa is almost exclusively concentrated among women. Therefore further analysis only focused on overweight in Sub Saharan women.

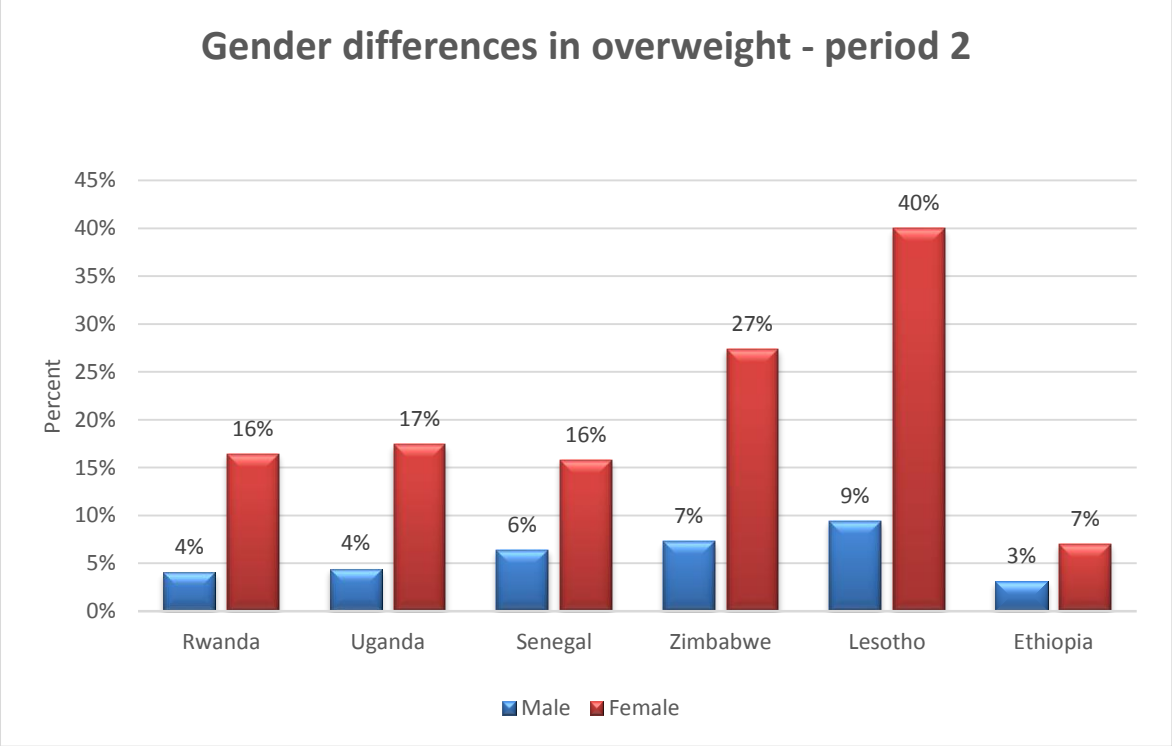


Figure 1: Gender differences in overweight, by country

Table 2 shows that less than fifty percent of women in all countries live in an urban setting. In particular Malawi shows a low share of women living in an urban setting, both in period 1 and 2. The number of females living in an urban setting has increased in Uganda, Senegal, Zimbabwe and Ethiopia. Probably, these countries become increasingly urbanized. In the other countries the percentage of urban females has slightly declined. Except for Rwanda, which shows a high decrease in the number of females living in an urban setting. However, conclusions should be drawn carefully as it concerns a cross sectional analysis with different females in period 1 and 2.

Remarkably, all countries show higher percentages for primary educated compared to secondary educated, except for Zimbabwe where more people are secondary educated. Nevertheless, the number of secondary educated increases in almost all countries. Especially Senegal experiences a high increase in the number of secondary educated (76.15 percentage points). Meanwhile Ethiopia shows a positive change in the number of primary educated (73.04 percentage points)

Another noteworthy point is the percentage of working females which is much lower in Senegal, Zimbabwe, Lesotho and Ethiopia compared to the other countries. However, the number of working females has increased considerably for Ethiopia (24.37 percentage points). The percentages of working females far exceed fifty percent in Rwanda, Uganda and Malawi.

Finally, the mean number of children is the lowest in Zimbabwe and Lesotho (n=2). It can be questioned whether this results from a higher economic development in Zimbabwe and Lesotho compared to the other countries. However, this does not correspond with Senegal having the highest GDP, but also the highest mean number of children in period 1. The maximum number of children is four in period 1 of Senegal and in both periods of Uganda.

Variables		Period 1	Period 2	Percentage point of change
Rwanda				
	% Married	35.79	43.09	20,40
	% Working	70.35	77.23	9,78
	Mean nr. Of children	3	3	0,00
	% Urban	22.98	17.96	-21,85
	% Primary educated	60.54	66.42	9,71
	% Secondary educated	11.88	15.48	30,30
Uganda				
	% Married	58.54	42.89	-26,73
	% Working	86.40	76.13	-11,89
	Mean nr. Of children	4	4	
	% Urban	17.52	30.80	75,80
	% Primary educated	54.42	52.87	-2,85
	% Secondary educated	19.83	28.81	45,28
Senegal				
	% Married	99.91	78.81	-21,12
	% Working	43.30	43.54	0,55
	Mean nr. Of children	4	3	
	% Urban	35.78	39.64	10,79
	% Primary educated	20.02	19.10	-4,60
	% Secondary educated	7.17	12.63	76,15
Zimbabwe				
	% Married	67.54	68.64	1,63
	% Working	41.73	41.07	-1,58
	Mean nr. Of children	2	2	
	% Urban	35.77	37.70	5,40
	% Primary educated	35.30	30.84	-12,63
	% Secondary educated	59.25	66.07	11,51
Lesotho				
	% Married	63.09	64.78	2,68
	% Working	44.56	44.24	-0,72
	Mean nr. Of children	2	2	
	% Urban	28.63	27.25	-4,82
	% Primary educated	60.65	53.16	-12,35
	% Secondary educated	36.35	38.73	6,55
Ethiopia				
	% Married	71.52	69.07	-3,43
	% Working	31.55	39.24	24,37
	Mean nr. Of children	3	3	
	% Urban	30.24	31.80	5,16
	% Primary educated	15.32	26.51	73,04
	% Secondary educated	17.72	14.39	-18,79
Malawi				
	% Married	76.32	69.62	-8,78
	% Working	60.77	61.84	1,76
	Mean nr. Of children	3	3	
	% Urban	13.57	13.27	-2,21
	% Primary educated	58.86	64.35	9,33
	% Secondary educated	13.07	17.45	33,51

Table 3 Description of the samples

When looking at the geographical variation in overweight among females in the second period (2010-2011), there is a clear difference in the prevalence of overweight between urban and rural areas. Figure 2 shows that in all countries, overweight is most concentrated among females living in urban areas. In every country a relatively higher percentage of females with overweight is living in urban areas compared to rural areas. In Lesotho for example, more than half of the females living in urban areas is overweight, while in rural areas of Lesotho a considerably smaller percentage of female is overweight (43%). The biggest difference in prevalence of overweight between females living in urban and rural areas exists in Uganda, followed by Malawi. In these countries, the variation in the prevalence of overweight between rural and urban areas is more than 50% (Uganda: 33% urban;14% rural. Malawi: 33% urban; 16% rural). These results show that – with the exception of Ethiopia - overweight in Africa is mainly concentrated among urban women .

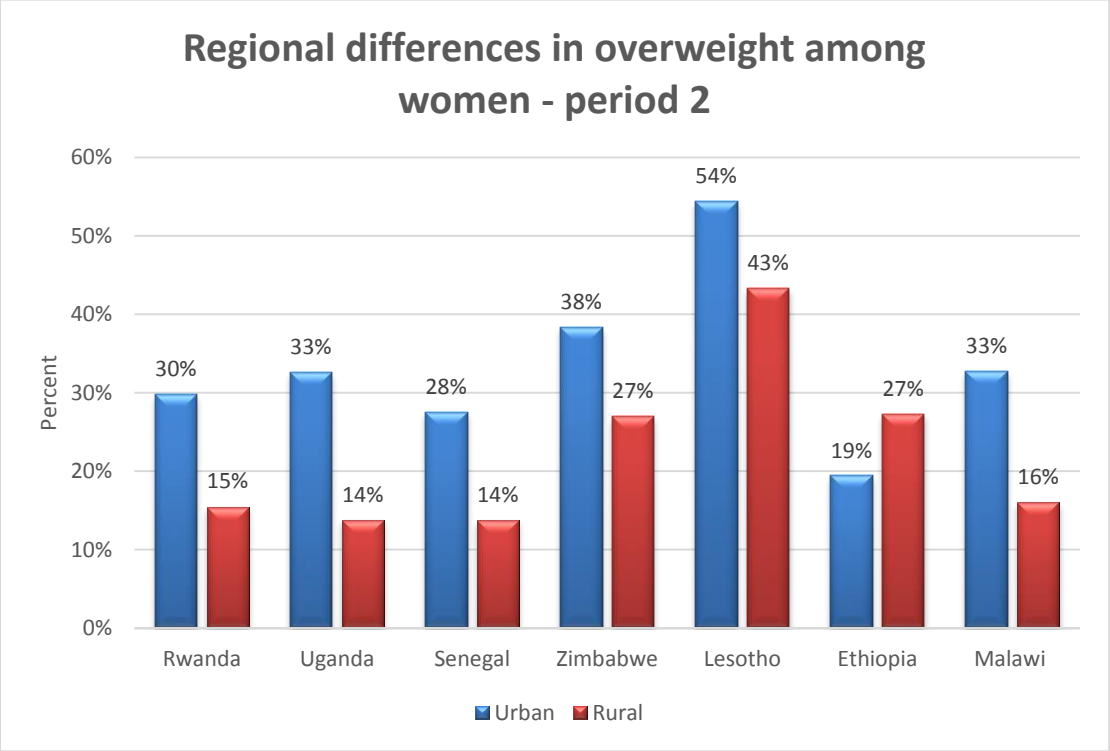


Figure 2: Regional differences in overweight among women, by country

	Period 1		Period 2		Change	
	% of overweight	Mean BMI	% of overweight	Mean BMI	Percentage point of change in overweight	% change in mean BMI
Rwanda	12,11	21,54	17,89	22,46	47,73	4,27
Uganda	15,06	20,65	19,22	21,01	27,59	1,74
Senegal	20,80	20,67	19,07	20,59	-8,32	-0,39
Zimbabwe	28,64	23,35	30,64	22,51	6,98	-3,60
Lesotho	46,55	25,58	46,10	25,69	-0,97	0,43
Ethiopia	6,42	19,43	8,08	19,30	25,86	-0,67
Malawi	13,35	20,94	18,35	22,58	37,45	7,83

Table 4 Change over time in the prevalence of overweight and mean BMI of females per country and period

After analyzing the cross sectional variation in overweight by region, it has been investigated whether a trend can be observed in the prevalence of overweight. Table 4 shows the country-specific trends in the prevalence of overweight. The first column shows the percentage of overweight during period 1. Lesotho, Zimbabwe and Senegal have the highest percentages of overweight. In Lesotho almost fifty percent of the population appears to be overweight. Contary, Ethiopia has the lowest percentage of overweight. The prevalence rates resulting from period 1 almost square with the findings of Cresswell (2012:1326). Although Cresswell shows a slightly higher prevalence ratio for Senegal (24.1%) and a slightly smaller prevalence ratio for Ethiopia (3.5%), the countries can be ranked the same by their prevalence ratios. The small difference in prevalence ratios probably stem from the use of a sample weight in Cresswell's ratios.

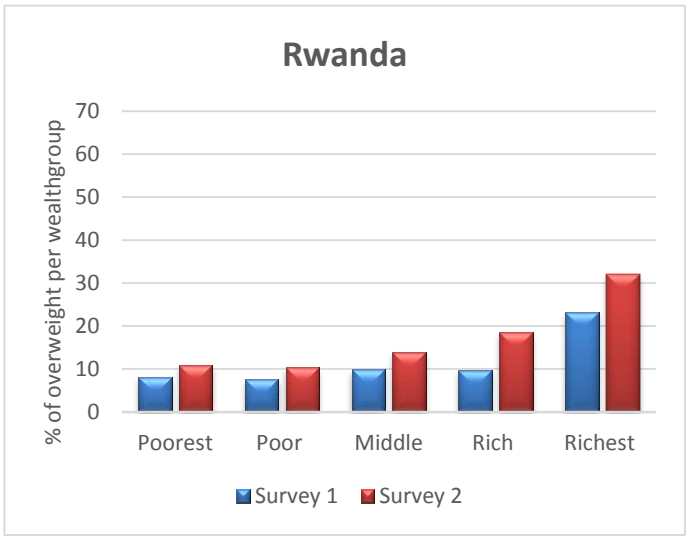
Ranking the countries by prevalence ratio for period 2 almost gives the same results as for period 1. Only Uganda's prevalence ratio now dominates the prevalence ratio of Senegal. Apart from Senegal and Lesotho, it seems that all countries experienced a positive trend in the prevalence of overweight between period 1 and 2. Relatively, the countries which show the biggest difference in the prevalence of overweight between period 1 and 2 are Rwanda, Uganda and Malawi. Senegal and Lesotho seem to have experienced a decline in overweight over time, which is interesting given the WHO announcement that the obesity epidemic increasingly affects low income countries. Even studies solely focusing on African countries proclaim overweight to be on the rise (Ziraba et al. 2009; Sodjinou et al. 2008; Biritwum 2005; Bourne 2002; Sobngwi et al. 2004). Nevertheless, the results might be influenced by sampling variability, because women are not followed over time. Therefore, conclusions about the trend in overweight should be drawn carefully.

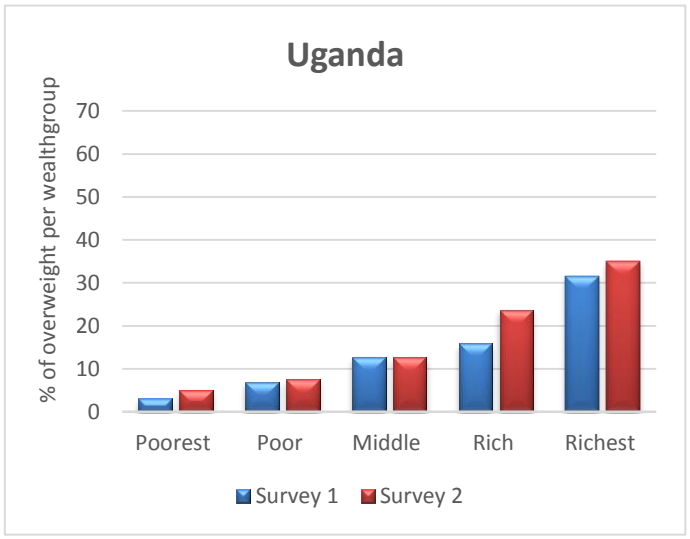
Additionally, table 4 shows the mean BMI in period 1 and 2 and subsequently describes the change in mean BMI over time. Malawi, Rwanda, Uganda and Lesotho show an increase in mean BMI. The first is confronted with the biggest increase (7.83 percentage points). Contrary, a decrease in mean BMI is observed for Zimbabwe, Senegal and Ethiopia. Reason for including the mean BMI is to show that a change in mean BMI and a change in overweight are not necessarily equal. It depends

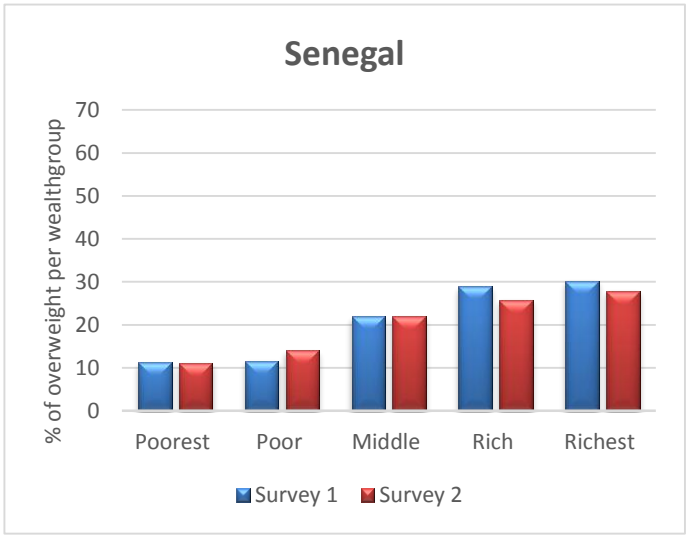
on the shape of the BMI distribution. A change in the distribution might lower the mean BMI (μ), but at the same time increase the percentage of the population crossing the BMI threshold of 25. This is for example the case in Zimbabwe and Ethiopia. As being a health scientist and knowing that only overweight leads to health problems, I am mainly interested in the trend of overweight.

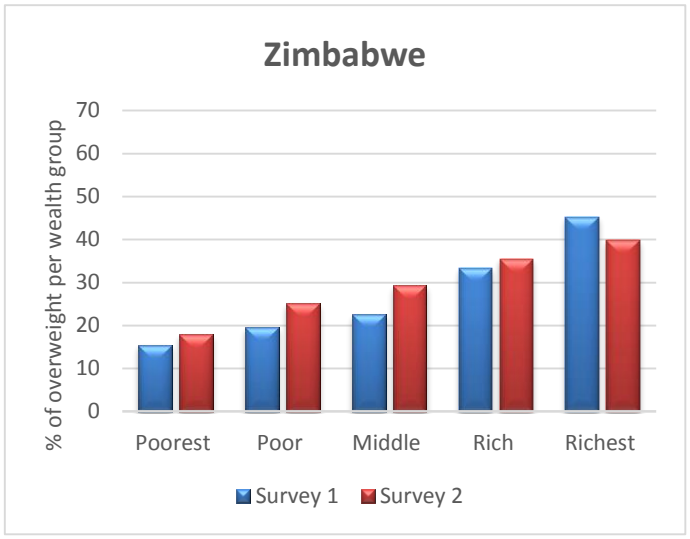
4.2 Wealth-related inequality in overweight

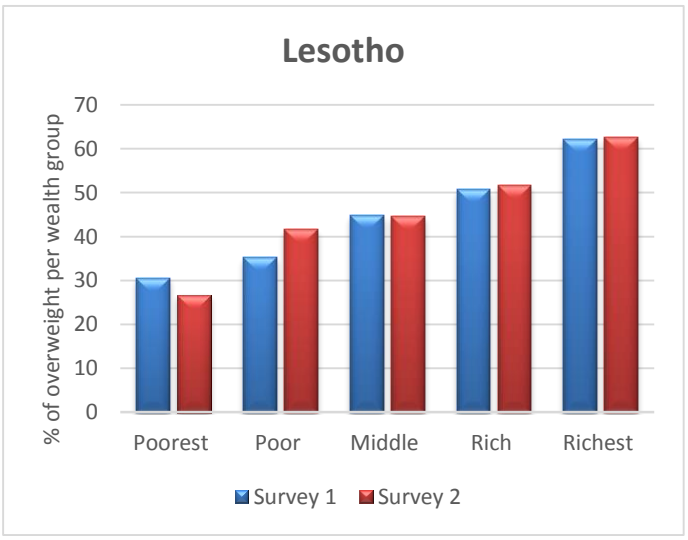
Figure 3 shows the distribution of overweight by wealth quintile groups per country. As the highest wealth groups of all countries show the highest prevalence ratios, overweight appears to be most concentrated among the rich. Rwanda, Uganda, Malawi and Ethiopia show an increase in the percentage of overweight for each wealth group. This is in line with the rise in the overall prevalence per country (table 4). Contrary, in Senegal, Zimbabwe and Lesotho not all wealth groups experienced an increase in the prevalence of overweight. The graph of Lesotho indicates that the lower prevalence ratio in period 2 results from the lower prevalence in the poorest wealth groups. Remarkable is the smaller percentage of overweight in the top wealth groups in Senegal and Zimbabwe during period 2. Even the 'richer' wealth group of Senegal shows a decrease in overweight. Despite the decrease in overweight in the top wealth group of Zimbabwe, the country shows an increase in the overall prevalence in period 2 (table 4). This can be explained by the compensation of the poorer wealth groups showing higher percentages of overweight in period 2. From the graphs it might be assumed that the inequality in overweight in Zimbabwe and Senegal, which disadvantages the rich, has become smaller. Another particular point concerns the relatively high percentage of overweight in the richest wealth group of Ethiopia, which has even become higher in period 2. Consequently, the inequality in Ethiopia seems to have increased. Noteworthy is the big difference in prevalence ratios between Lesotho and Ethiopia. Although both countries are in Sub Saharan Africa, the graphs shows that the size of the overweight problem is not equal within these countries. However, the inequality in overweight in Lesotho seems to have decreased, while the graph of Ethiopia shows the reverse. From the other graphs it is difficult to derive whether the inequality has increased or decreased in those countries. It seems that the inequality has increased for Rwanda, Uganda and Malawi, while it might have decreased for Lesotho. The change in inequality is quantified by concentration indices to enable a better interpretation of the trend in the wealth related inequality in overweight.

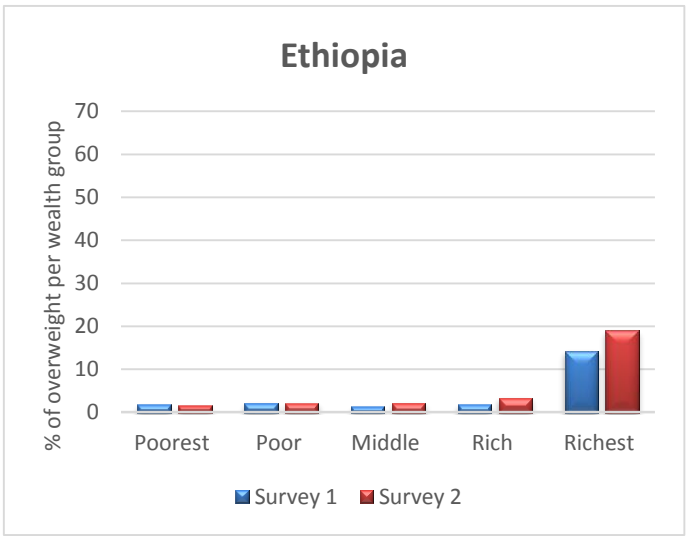

Rwanda
% of overweight per wealthgroup
70
60
50
40
30
20
10
0
Poorest
Poor
Middle
Rich
Richest
Survey 1
Survey 2


Uganda
% of overweight per wealthgroup
70
60
50
40
30
20
10
0
Poorest
Poor
Middle
Rich
Richest
Survey 1
Survey 2


Senegal
% of overweight per wealthgroup
70
60
50
40
30
20
10
0
Poorest
Poor
Middle
Rich
Richest
Survey 1
Survey 2


Zimbabwe
% of overweight per wealth group
70
60
50
40
30
20
10
0
Poorest
Poor
Middle
Rich
Richest
Survey 1
Survey 2


Lesotho
% of overweight per wealth group
70
60
50
40
30
20
10
0
Poorest
Poor
Middle
Rich
Richest
Survey 1
Survey 2


Ethiopia
% of overweight per wealth group
70
60
50
40
30
20
10
0
Poorest
Poor
Middle
Rich
Richest
Survey 1
Survey 2

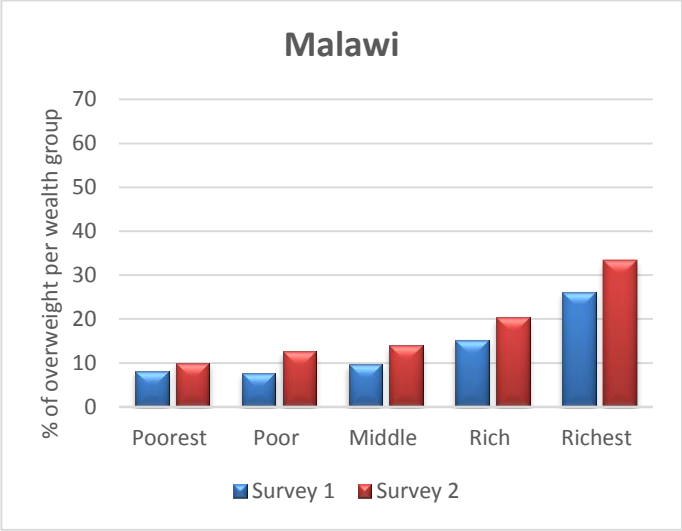


Figure 3 Wealth related in equality in overweight across the different countries

4.3 Corrected concentration index per country

	Period 1			Period 2			Difference		
	CC	μ	T	CC	μ	T	ΔCC	Δμ	T
Rwanda	0.111	0.121	8.390	0.182	0.179	14.010	0.072	0.058	4,212
Uganda	0.274	0.151	12.570	0.299	0.192	12.470	0.025	0.042	0,764
Senegal	0.182	0.208	8.960	0.164	0.190	8.180	-0.018	-0.018	-0,476
Zimbabwe	0.278	0.286	20.130	0.229	0.306	16.040	-0.049	0.020	-2,766
Lesotho	0.276	0.465	10.900	0.255	0.461	10.790	-0.021	-0.004	-0,673
Ethiopia	0.086	0.064	8.150	0.141	0.081	16.230	0.055	0.017	3,714
Malawi	0.155	0.134	12.870	0.205	0.184	11.740	0.050	0.050	2,934

Table 5: Changes in the CC for overweight per country

Table 5 shows that the concentration indices of all countries for both samples are positive, confirming that overweight appears to be most concentrated among the wealthiest population groups during both period 1 and 2. The t-values indicate that the concentration indices are statistically significantly different from zero for all countries, as well as the changes (except in Lesotho, Senegal and Uganda) between both periods. However, the magnitude of the concentration indices differs between the countries and periods, which means that the size of the inequality differs between countries and over time.

Firstly, in period 1, Zimbabwe had the greatest wealth related inequality in overweight (C.I. = 0.278), followed by Lesotho, Uganda, Senegal, Malawi and Rwanda. Ethiopia had the lowest inequality. In period 2 Uganda appeared to have the greatest wealth related inequality in overweight (C.I. =0.299). Uganda is now followed by Lesotho, Zimbabwe, Malawi, Rwanda and Senegal.

As shown by table 5 and figure 4, the CCs of Rwanda, Uganda, Ethiopia and Malawi increased over time. Only the increase in Uganda's CC is not significant (T=0.764<1.96). Rwanda and Ethiopia experienced the biggest increase in inequality (ΔCC =0.072; ΔCC =0.055). The latter is noteworthy given the fact that Rwanda and Ethiopia had the lowest inequality of all countries in period 1. Together with the remarkable decline in the CC of Zimbabwe, Lesotho and Senegal it seems that Rwanda and Ethiopia are catching up. However, it should be noted that the decline in Lesotho and Senegal is not significant (-1,96<T<1,96).

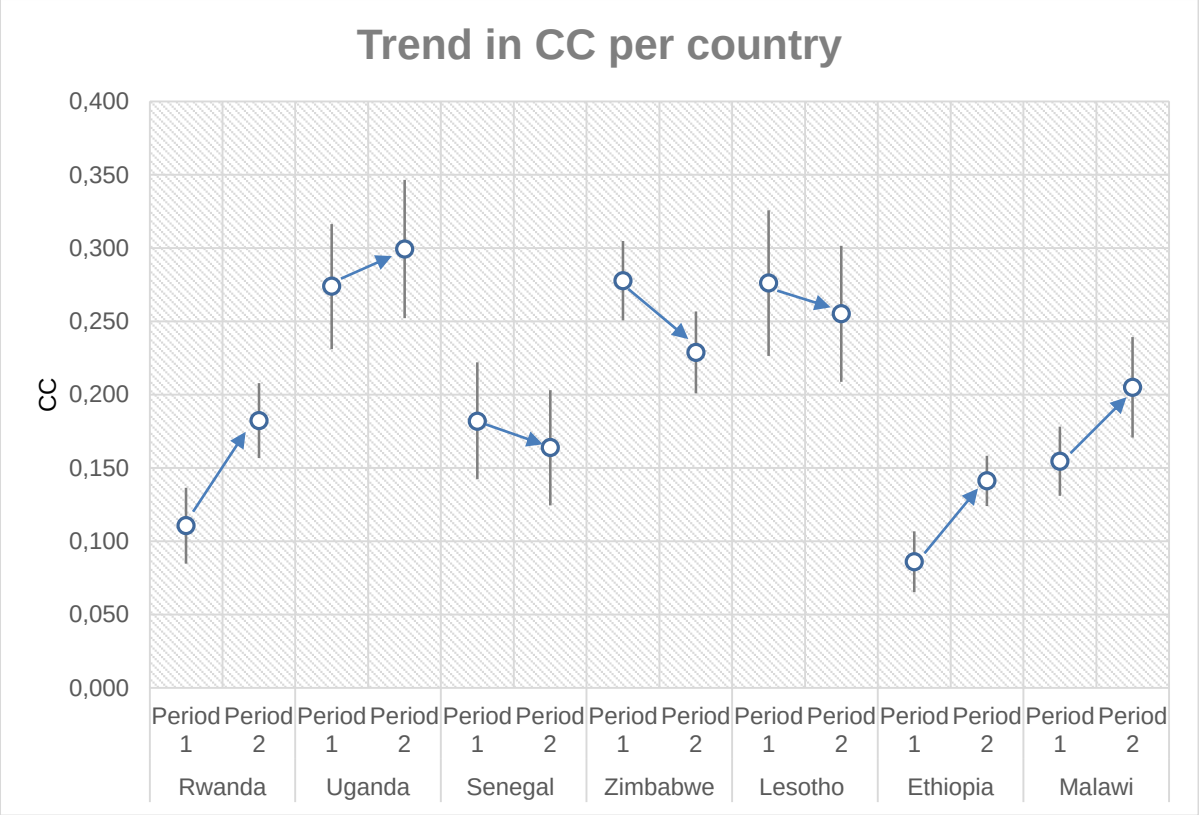


Figure 4 Trend in the CC (with confidence intervals) per country

To indicate whether the socioeconomic distribution of overweight is associated with economic development, the graph below visualizes the relationship between the countries' GDP per capita and the associated corrected concentration index in both periods. The countries which show a positive trend in overweight inequality are also the countries with the lowest GDP during period 1 (Ethiopia, Malawi, Uganda and Rwanda). Contrary, Zimbabwe, Lesotho and Senegal showing a GDP above 400 US dollars per capita in period 1, all experience a negative trend in overweight inequality. Subsequently, the graph suggests that overweight becomes less concentrated among the top wealth groups in Sub Saharan Africa with continuing economic development. This confirms the results of Tafreschi (2012:10) who showed a negative relationship between a country's concentration index and its GDP. Eventually the socioeconomic distribution of overweight might change towards the least wealthy population groups in Sub Saharan Africa.

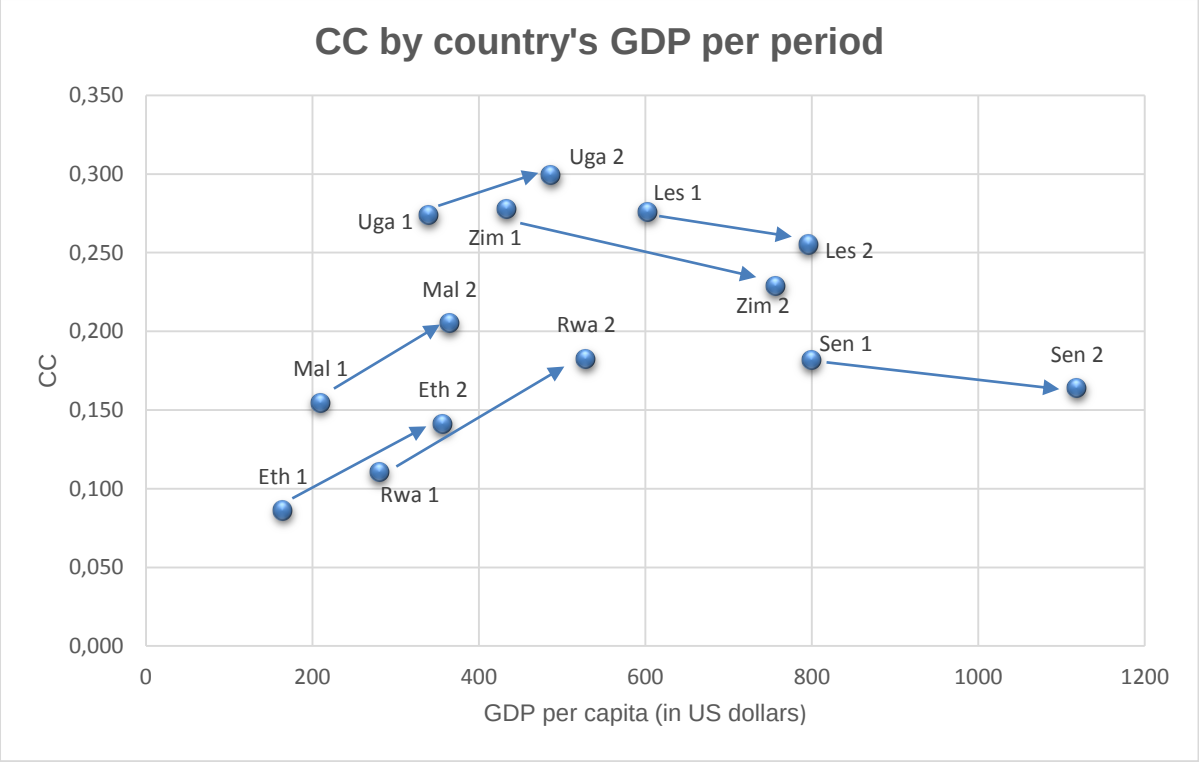


Figure 5 CC by country's GDP per period

4.4 Decomposition of the corrected concentration index

The results of the decomposition are shown in table 6-13, in appendix 1. It is obvious that wealth is by far the most important contributor to inequality in overweight in all countries. As described in the methods section, the factor specific contribution results from the sensitivity of overweight with respect to the specific factor (β) and the wealth related inequality in the factor itself (CC). The high positive β's for wealth show that overweight is positively related to household wealth in all countries. However the magnitude of the β's differs per country. Especially Lesotho shows a strong association of overweight with wealth. In period 2 the richest wealth group of Lesotho had a 35% higher probability to be overweight than the poorest wealth group. In Ethiopia this is only 12 % in the second period and almost no difference in probability exists between the rich and poor in the first period. This increase in overweight among the richest wealth groups may suggest that Ethiopia is catching up in terms of inequality compared to the other countries.

Another important contributor of overweight in all countries is living in an urban setting. In particular Uganda, Senegal, Malawi and Ethiopia show a high contribution of urban compared to the other explanatory factors. Particularly Senegal shows a high contribution of urban in period 2, which is driven by a high concentration of the urban rich having a 9.9% higher probability to be overweight compared to the rural people (table 9). Also overweight in Malawi has become more sensitive to the urban factor in period 2, where the urban have a 7.4 % higher chance to be overweight compared to

their rural counterparts. Combined with more rich living in urban Malawi, the contribution is higher in period 2 (table 13). Contrary, Ethiopia shows a considerable higher contribution of urban in the first period (table 12). This results from the lower probability of the urban to be overweight in period 2. Remarkably, Lesotho shows a negative contribution for the urban factor, both in period 1 and 2 (table 11). The exception is caused by the negative coefficient of urban with respect to overweight, indicating a negative association between overweight and living in an urban area. Together with a higher concentration of the top wealth group in urban Lesotho (positive CC), this results in a negative contribution. Only in Rwanda urban makes a relative small contribution to the CC (table 6).

The majority of countries show education to be the third most important contributor of the wealth related inequality in overweight. Apart from Uganda, education positively contributes to the CC in all countries. In Rwanda, Senegal, Zimbabwe, Ethiopia and Malawi the positive contribution is mainly the result of the secondary educated having a higher probability to be overweight compared to the non-educated, combined with a higher concentration of wealthy people being secondary educated. Remarkably, Lesotho shows overweight to be negatively related to education. However, the contribution of education is positive due to the high concentration of poor being primary educated, which have a slightly lower chance to become overweight (table 11). Uganda is the only country where education shows a negative contribution. In period 2 education decreases the inequality with 10 percent, which is mainly the result of the secondary educated having a 6.2 % smaller chance to be overweight than the non-educated together with a higher concentration of the rich being secondary educated (table 7).

4.5 Decomposition of change in the corrected concentration index

To explain the trend in inequality over time, the change in the CCs has been decomposed as well (see appendix 2). As described earlier, Rwanda, Uganda, Ethiopia and Malawi show an increase in the inequality of overweight (disadvantaging the rich). Contrary, Zimbabwe, Senegal and Lesotho show a decrease in the inequality of overweight (disadvantaging the rich).

Most of the change in the CC of Rwanda, Uganda, Ethiopia and Senegal can be attributed to a change in wealth. In Rwanda, Uganda and Ethiopia the effect of wealth on overweight has risen. In Rwanda and Uganda this effect is mainly determined by an increased effect of belonging to the richer wealth groups on overweight. The increased effect of wealth in Ethiopia results mainly from the increased effect of belonging to the top wealth group. Only in Senegal the effect of wealth on overweight has decreased, contributing to a decrease in the inequality of Senegal. Wealth does not explain a large part of the decrease in inequality in Lesotho due to a further increase in the probability of the rich to be overweight.

Education also contributes to the change in the concentration index of Senegal, Lesotho, Uganda, Zimbabwe and Ethiopia. Education negatively contributes to the increase in the inequality in Uganda and Ethiopia and positively contributes to the decrease in inequality in Senegal. In Lesotho and Zimbabwe, only secondary education positively contributes to the decrease in inequality. Above results stem from the decreased probability of educated compared to non-educated to become overweight. For Ethiopia, this is quite remarkable. Being the least developed country, I would not already expect a decreased effect of education on overweight. However, the negative contribution of education is still very small compared to the high positive contribution of wealth to the increased concentration index.. Although being both socioeconomic indicators, education and wealth show an opposite contribution to the inequality within Uganda and Ethiopia. This might be explained by education and wealth being differently related to the prevalence of overweight (Mendez et al. 2005:720; Abdulai 2010:167). While wealth increases the inequality in overweight, education decreases the inequality in overweight. Higher educated might be better able to translate their greater health knowledge into healthy behavior, manifested in the consumption of healthy food and increased physical activity compared to the non-educated (Nayga 2000). However, being in a different stage of economic development might vary the potential influence of different socioeconomic status (SES) measures on the probability to have overweight between countries (Mendez et al. 2005:720). This is confirmed by the results of the most developed countries, Senegal and Lesotho, in which both wealth and secondary education have decreased the inequality in overweight.

Finally, urbanization seems to be an important explanatory factor of the change in inequality in some countries. However the effect differs per country. Urbanization positively contributes to the decrease in inequality in Zimbabwe and Lesotho. The contribution in Zimbabwe can be explained by an increased concentration of the poor in urban area who have a positive probability to get overweight. Probably, the urban poor are purchasing cheap unhealthy food containing high levels of sugar and fat. In the future this might even lead to a shift in the concentration of overweight towards the urban poor of Zimbabwe, due to their limited opportunities to adopt a healthier lifestyle (Ziraba et al. 2009:2).

The contribution of urbanization in Lesotho results mainly from overweight being negatively related to an urban lifestyle, because the concentration of the rich in urban areas continually increases. Probably, the rich in urban areas are adopting a more healthy lifestyle.

Remarkably, the decrease in inequality in Senegal cannot be attributed to urbanization, which shows a positive contribution. Despite the decreased inequality in overweight, the concentration of rich people living in urban areas of Senegal and their probability to get overweight have increased. Presumably, the concentration index of Senegal might decrease even further when the concentration of poor people in urban areas starts to increase, which is the case in Zimbabwe (assuming a positive probability of urban with respect to overweight).

Contrary, the overall inequality in Malawi and Ethiopia has increased leading to a different

interpretation of the urban' contribution. Although both countries experience an increase in the concentration of rich people in urban areas, the probability to be overweight has increased in Malawi and decreased in Ethiopia. Consequently, the urban factor positively contributes to an increase in the inequality in Malawi and negatively contributes to an increase in inequality in Ethiopia. A possible explanation for the different contributions could be that Ethiopia, as being the least developed country, is at the beginning of its economic development in which urbanization does not yet translate into a higher calorie intake or lower calorie expenditure. The lagging industrialization does not yet enable the adoption of an urban lifestyle. The increased effect of living in an urban setting on overweight in Malawi, Zimbabwe and Senegal might be explained by an increased provision of unhealthy food in Malawi's cities, which increases the calorie intake. Otherwise, it could also be explained by a decrease in calorie expenditure due to industrialization substituting labor intensive work for more sedentary occupations (Philipson & Posner 2003). Alternatively, the cultural perception might play an increasing role in the rise of overweight in Malawi (Abubakari et al. 2008) (Monteiro et al. 2004:1185).

Conclusion and discussion

The rationale for this study derives from the WHO report “Obesity: preventing and managing the global epidemic” which proclaimed obesity as being a worldwide epidemic, which is increasingly effecting low income countries. Also Africa is nowadays confronted with the obesity epidemic. The aim of this study was to investigate the trend in the socioeconomic distribution of overweight in Sub Saharan Africa and how this trend can be explained.

The study focused solely on the trend in overweight among women, as the analysis showed that Sub Saharan African women are most at risk for becoming overweight. The prevalence of overweight appeared to be higher in urban areas for all countries. This is in line with the literature, which presented that urban residents in developing countries are more likely to be overweight than their rural counterparts (Abubakari et al. 2008:306) (Popkin et al. 2012:3) (Mendez et al 2005:716) (Ziraba et al. 2009:2).

The increasing prevalence rates of overweight in Sub Saharan Africa as shown in the literature are confirmed by this study (Ziraba et al. 2009; Sodjinou et al. 2008; Biritwum 2005; Bourne 2002; Sobngwi et al. 2004). All countries showed an upward trend in the prevalence of overweight – except for Lesotho and Senegal. However, the prevalence ratios of Lesotho and Senegal remain relatively high. Remarkably, the countries experiencing the highest prevalence of overweight (Lesotho, Zimbabwe Senegal and Uganda) also experience the highest inequality in overweight. In pursuance of earlier studies investigating the socioeconomic distribution of overweight in developing countries, overweight is most found among the richer inhabitants in all countries. Apart from Senegal, Lesotho and Zimbabwe, the inequality in overweight even grows over time, increasingly disadvantaging the rich. Accordingly a shift in the socioeconomic distribution of overweight as described by Tafreschi (2012:10) is not yet observable in these countries. However, the most developed countries (Senegal, Lesotho and Zimbabwe) show a decrease in the inequality, which favors the rich. As shown by figure 1, the decrease is simultaneous to the increase in the countries’ GDP which provides empirical evidence for the findings of Tafreschi (2012). He states that the concentration index is negatively related to GDP. When the negative trend in the concentration index proceeds with economic development, the inequality in overweight might slowly shift towards the poor in Senegal, Lesotho and Zimbabwe

Inequality in overweight can be explained differently for each country. However, it appears that wealth is by far the most important contributor to the inequality in overweight. Although the contribution can be mainly explained by overweight being highly sensitive to wealth, the degree to which this is the case differs significantly between the countries. Remarkable is the stronger relation in between overweight and wealth in Zimbabwe and Lesotho (i.e. countries with a relative high GDP) compared to the other countries. This could be explained by the theory of Philipson & Posner (2003) which relates the increase in overweight to the decrease in the relative food price due to improved

technology. A lower food price in richer countries enables its population to purchase more food, given a certain level of wealth. Furthermore, the supply of sedentary jobs in richer countries might be higher due to more advanced technology in these countries. Subsequently, the calorie expenditure might be lower compared to the other countries, which induces a larger weight gain (Philipson & Posner 2003). Contrary, Senegal (i.e. country with the highest GDP) shows a decreased effect of wealth on overweight for the top wealth groups in period 2. Probably, the top wealth groups have surpassed their optimum weigh. More utility will be derived from losing weight to get a better health status. This follows the trend which is observable in more technically advanced countries (Philipson & Posner 2003:90).

Urbanization also contributes largely to the inequality in overweight, especially in Uganda, Senegal, Malawi and Ethiopia (period 1). Urban residents in these countries have a higher chance to be overweight. Whereas urban areas are mostly inhabited by the rich, this results in a pro rich concentration of overweight. In Malawi the contribution of urbanization has even risen over time. Noteworthy is the negative contribution of urbanization to the inequality in overweight in Lesotho. This can be explained by overweight being negatively related to the urban life style in Lesotho. The urban-rural difference in the probability to be overweight becomes even smaller over time, which can be explained in two ways. The urban rich might adopt a healthier lifestyle or the rural counterparts in Lesotho are catching up. Urbanization pulls the economic development of rural areas by providing improved infrastructure and facilities. This might also allow rural residents to adopt an urban lifestyle (Mendez 2005 et al. :719). Alternatively, rural counterparts might receive money from family member, which allows for a change in food demand (Prentice 2006:96).

Finally, education turned out to be another important contributor to the inequality in overweight. Education positively contributes to the increased inequality in overweight in Rwanda, Malawi and Ethiopia. The contribution results from educated people showing a higher probability to be overweight compared to non-educated. Contrary, the secondary educated in Uganda, Senegal, Lesotho and Zimbabwe show a lower probability to be overweight than the non-educated. Where being secondary educated is most common to the rich, education negatively contributes to the inequality in overweight. This can be explained by secondary education enhancing awareness of the negative health consequences of overweight (Nayga 2000). However, Uganda still experiences a positive change in the inequality. Possibly, the negative contribution of education will dominate the effect of wealth on the inequality in overweight in the future, subsequently initiating a negative change in the socioeconomic distribution of overweight. This can already be observed in the countries Senegal, Lesotho and Zimbabwe, where inequality in overweight has partly declined due to the contribution of secondary education.

Limitations

Firstly some limitations are put by focusing only on overweight as an indicator for the health status of the Sub Saharan population. Although Monteiro et al. (2004) calls obesity a disease in its own right, it is only one of the risk factors for the arising NCDs in Sub Saharan Africa (Negin et al. 2011).

Subsequently, this study embraces only a part of the emerging NCD problem. Alternatively, I could have taken the amount of NCD deaths to respond to the arising NCD problem. Furthermore, the double burden of disease in Sub Saharan Africa is most concentrated among the poor while overweight is mainly a problem of the rich. The top wealth groups in Sub Saharan Africa only face the burden of NCDs (Marquez & Farrington 2012). As overweight might not be an adequate indicator for the arising double burden in Sub Saharan Africa, it could be questioned whether this study contributes to the examination of the largest faced challenge by Sub Saharan Africa (i.e. the double burden of disease).

By examining the socioeconomic trend in overweight, the study did not capture the cultural perception of populations regarding overweight. As overweight is an indicator for a wealthy lifestyle in African cultures, it could be that these cultural perceptions are more common in the top wealth groups. Therefore it should be included in the explanation of the socioeconomic inequality in overweight. However, the DHS datasets do not include data on this topic. Moreover, cultural perceptions concern subjective information which impedes the measurement in quantitative terms.

Another limitation concerning my research question is the primary focus on adult population, herewith ignoring the overweight problem among children in Sub Saharan Africa. Also children in developing countries become increasingly overweight (Onywera 2010:45). Studies from developed countries have shown that childhood obesity is a significant predictor for obesity during adulthood (Lasserre 2007:157). Moreover, the level of wealth during childhood is associated with the probability to become overweight during adulthood (Parsons et al. 1999). Consequently, the wealth related inequality in overweight could have been underestimated in this study due to missing data on overweight in children and adult overweight not only being related to current wealth but also previous wealth. The BMI of children as well as their household wealth could be derived from the DHS data, however reason for not including overweight in children in this study is the incomparability between the body composition of adults and children. Children do not yet have attained their full body size, which requires different size criteria (Creswell 2012: 1326; Cole 2007:6).

It should be considered that the lack of data on income in DHS surveys precluded the use of income as an indicator for the economic status of individuals. Alternatively, the wealth index is used to provide insights in the relative wealth of individuals within a country. However, the composition of the wealth index is based on an individual's assets and therefore concerns an indirect measure of wealth. A time lag exists between an individual's earnings and the purchase of assets. However, overweight partly results from a direct translation of increased income into a higher food purchase. Therefore, the wealth index might not be a perfect alternative indicator for an individual's financial resources in the measurement of wealth related inequality in overweight (Hruschka & Brewis 2012:7; Jones Smith 2011:674; Rutstein 2008). Also it should be considered whether the same wealth index can be applied to rural as well as urban areas. Rutstein (2008:4) discusses the concern about the original construction of the wealth index which favors urban residents by including assets and services which are more frequently used by urban residents. Consequently the inequality in wealth might be overestimated, assigning more wealth to urban residents

Another technical limitation resulting from my analysis is the inclusion of women who are three or less months postpartum in the sample. This might overestimate the prevalence of overweight, because these women might be of normal weight three months after giving child birth.

Finally, my study is limited by the usage of cross sectional datasets to explore a trend in the wealth related inequality in overweight. Although it enables an exploration of the rise in wealth related inequality in wealth, it does not include the same women followed over time. Consequently, the results could be subject to sampling variability. Therefore conclusions about a possible trend in the wealth related inequality in overweight should be taken carefully.

As overweight in Sub Saharan Africa is nowadays mostly concentrated among the rich it could be questioned whether the current socioeconomic distribution of overweight is a major problem for health policy makers. However it might be assumed by the results of this study and the literature that the socioeconomic distribution of overweight will shift towards the poor in the future. Together with the initial but still relevant prevalence of infectious diseases, the countries will be confronted with a double burden of disease concentrated among the poor. Regarding the already scarce facilities and resources within those countries, the extra burden of disease causes a serious threat for the sustainability of the health care facilities and eventually the population's health. For this reason, it is important to monitor the trend in the socioeconomic distribution of overweight and to see by which the trend might be explained. Wealth, urbanization and education should be taken into consideration as important contributors to the socioeconomic inequality in overweight. The degree in which these factors contribute to the inequality in overweight is country-specific. However, education seems to become more important with a higher stage of economic development. Understanding the socioeconomic distribution in overweight will guide policymakers in addressing the overweight problem in Sub Saharan Africa.

References

Abdulai, A. 2010. 'Socioeconomic characteristics and obesity in underdeveloped economies: does income really matter?'. *Applied Economics* 42:157-169.

Abubakari, A.R. et al. 2008. 'Prevalence and time trends in obesity among adult West African populations: a meta-analysis'. *Obesity reviews* 2008 (8):297-311.

Amoah, A.G. 2003. 'Sociodemographic variations in obesity among Ghanaian adults'. *Public Health Nutrition* 6(8):751-757.

Biritwum R., Gyapong J. & G. Mensah. 2005. 'The epidemiology of obesity in ghana'. *Ghana Medical Journal* 2005, 39(3):82-85.

Boerma, J.T. & Sommerfelt A.E. 1993. 'Demographic and health surveys (DHS): contributions and limitations' *World Health Stat* Q 46(4):222-6.

Bourne L.T., Lambert E.V. & K. Steyn. 2005. 'Where does the black population of South Africa stand on the nutrition transition?' *Public Health Nutrition* 5(1A):157-162

Cole, T.J. 2007 'Body mass index cut offs to define thinness in children and adolescents: international survey'. BMJ 2007 335 (194): 1-8

Cresswell, J.A., Campbell, O.M.R., De Silva, M.J. & V. Filippi. 2012. Effect of maternal obesity on neonatal death in sub-Saharan Africa: multivariable analysis of 27 national datasets. *Lancet* 2012 380: 1325-1330

Erreygers, G. 2009. 'Correcting the Concentration Index' *Journal of Health Economics* 28:504- 515.

Erreygers, G., T. van Ourti. 2010. *Measuring Socioeconomic Inequality in Health, Health care and Health Financing by Means of Rank Dependent Indices: a Recipe for Good Practice*. Amsterdam: Tinbergen Institute.

Fezeu L., Minkoulou E., Balkau B., Kengne A.P., Awah P., Unwin N., Alberti G.K. & J.C. Mbanya. 2006. 'Association between socioeconomic status and adiposity in urban Cameroon'. *International Journal of Epidemiology* 35(1):105-111.

Kakwani, N.C., A. Wagstaff & E. van Doorslaer. 1997. 'Socioeconomic Inequalities in Health: Measurement, Computation an d Statistical Inference'. *Journal of Econometrics* 77 (1):87-104.

Kjellsson, G. & U.G. Gerdtham. 2011. *Correcting the concentration indices for binary variables*. Lund: Lund University Department of Economics

Hosseinpoor, A.R. et al. 2012 Socioeconomic inequalities in risk factors for non-communicable diseases in low-income countries and middle-income countries: results from the world health surveys. *BMC Public Health* 12 (912): 1-13

Hruschka D.J. & A.A. Brewis. 2012. Absolute wealth and world region strongly predict overweight among women (ages 18-49) in 360 populations across 36 developing countries. *Economics and Human Biology* 2012: 1-8

Jones-Smith, J.C., Gordon-Larsen, P., Siddiqi, A. & B.M. Popkin. 2011. 'Cross-national comparisons of time trends in overweight inequality by socioeconomic status among women using repeated cross-sectional surveys from 37 developing countries, 1989–2007' *American Journal of Epidemiology* 2011 (173) 667–675

Lakdawalla, D. & T. Philipson. 2002. The growth of obesity and technological change: a theoretical and empirical examination. Cambridge: National Bureau of Economic Research

Lasserre, A.M., Chiolero, A., Paccaud, F. & P. Bovet. 2007. 'Worldwide trends in childhood obesity'. *Swiss Medical Weekly* 137:157–158

Marquez, P.V. & J.L. Farrington. 2012. 'No more disease silos for sub-Saharan Africa'. BMJ 2012 345:1-5

(Measure DHS) 2013a. *Data collection* [Internet]. Measure DHS 25-04-2013 [25-04-2013] Available by http://measuredhs.com/data/data-collection.cfm

(Measure DHS). 2013b. *What we do* [Internet]. Measure DHS 25-04-2013 [25-04-2013] Available by: http://www.measuredhs.com/What-We-Do/Survey-Types/DHS.cfm

Mendez, M.A., Monteiro, C.A. & B.M. Popkin. 2005. 'Overweight exceeds underweight among women in most developing countries'*. The American Journal of Clinical Nutrition* 81:714-721

Monteiro, C.A., W.L. Conde, B. Lu & B.M. Popkin. 2004. 'Obesity and inequities in health in the developing world'. *International Journal of Obesity* 28:1181-1186

Nayga, R.M. 2000 'Schooling, health knowledge and obesity' *Applied Economics* 32 (7): 815-822

Negin, J. Cumming, R. Stewart de Ramirez, S. Abimbola, S. & S. Ehrlich Sachs. 2011. 'Risk factors for non-communicable diseases among older adults in rural Africa'. *Tropical Medicine and International Health* 16 (5): 640–646

Neuman, M., J.E. Finlay, G.D. Smith & S.V. Subramanian. 2011. 'The poor stay thinner: stable socioeconomic gradients in BMI among women in lower- and middle-income countries'. *American Journal of Clinical Nutrition* 94:1348-1357

Onywera, V.O. 2010. 'Childhood obesity and physical inactivity threat in Africa: strategies for a healthy future'. *Global Health Promotion* (2): 45–46

Parsons T.J., Power C., Logan S. & C.D Summerbell, 1999. 'Childhood predictors of adult obesity: a systematic review'. I*nternational Journal for Obesity Related Metabolic Disorder* (8):100-107

Philipson, T.J. & R.A. Posner 2003. 'The Long-Run Growth in Obesity as a Function of Technological Change' *The Johns Hopkins University Pres* 46(3):87-107

Popkin, B.M, Adair, L.S. & S.W. Ng. 2012. 'Now and then: the global nutrition transition: the pandemic of obesity in developing countries'. *Nutrition Review* 70 (1): 3:21

Prentice, A.M. 2006. 'The emerging epidemic of obesity in developing countries'. *International Journal of Epidemiology* 35: 93-99

Rutstein, S.O. & G. Rojas. 2006. *Guide to DHS statistics*. Washington: USAID.

Rutstein, S.O. 2008. *The DHS Wealth Index: Approaches for Rural and Urban Areas.* Washington: USAID.

Smits, J. & R. Steendijk. 2012. *The International Wealth Index (IWI).* Nijmegen: Nijmegen Center for Economics (NiCE) Insitute for Management Research Radboud University Nijmegen.

Sobngwi E., Mbanya J.C., Unwin N.C., Porcher R., Kengne A.P., Fezeu L., Minkoulou E.M., Tournoux C., Gautier J.F., Aspray T.J. et al. 2004. 'Exposure over the life course to an urban environment and its relation with obesity, diabetes, and hypertension in rural and urban Cameroon'. *International Journal of Epidemiology* 33(4):769-776.

Sodjinou, R., Agueh, V., Fayomi, B. & H. Delisle. 2008. 'Obesity and cardiometabolic risk factors in urban adults of Benin: relationship with socioeconomic status, urbanisation, and lifestyle patterns'. *BMC Public Health* 8:84.

Tafreschi, D. 2012. *The income body weight gradients in the developing economy of China.* St. Gallen: School of Economics and Political Science

(USAID). 2009. *Measure DHS Demographic and Health Surveys. Qualtiy information to plan, monitor and improve population, health and nutrition programs* [Internet]. Measure DHS, 23-06-2009 [03-05-2013]. Available by http://www.measuredhs.com/Who-We-Are/upload/MEASURE_DHS_Brochure.pdf

Vaessen, M. 1996. 'The potential of the Demographic and Health Surveys (DHS) for the evaluation and monitoring of maternal and child health indicators'. *Demographic Evaluation of Health Programmes* [65-74].

(WHO). 2000. *Obesity: preventing and managing the global epidemic. Report of a WHO consultation.* Geneva: WHO.

(Worldbank). 2013a. *Analyzing Health Equity Using Household Survey Data. Lecture 8 Concentration index* [Internet]. Worldbank [03-05-2013] Available by: http://siteresources.worldbank.org/INTPAH/Resources/Publications/459843-1195594469249/L8ConcentrationIndex.ppt

(World Bank) 2013b. World Bank Economic Indicators [Internet] Worldbank [14-05-2013] Available by: http://data.worldbank.org/indicator/NY.GDP.PCAP.CD

Ziraba, A.K., J.C. Fotso & R. Ochako. 2009. 'Overweight and obesity in urban Africa: a problem of the rich or the poor?' *BMC Public Health* 9 (465): 1-8

Appendix

Appendix 1 – Decomposition of the corrected concentration index

Rwanda	Period 1 (2005)				Period 2 (2010)			
	β	CC	Contribution	Percent contribution	β	CC	Contribution	Percent contribution
Age (ref: (20-24))	**-0,091**	**-0,034**	**0,003**	**3%**	**-0,056**	**-0,065**	**0,001**	**1%**
age (25-29)	-0,019	0,042	-0,001	-1%	-0,010	-0,003	0,000	0%
age (30-34)	-0,007	0,021	-0,000	0%	-0,003	0,001	-0,000	0%
age (35-40)	-0,024	-0,004	0,000	0%	-0,017	-0,021	0,000	0%
age (>40)	-0,041	-0,093	0,004	3%	-0,026	-0,042	0,001	1%
Education (ref: no education)	**0,031**	**0,215**	**0,011**	**10%**	**0,042**	**0,204**	**0,013**	**7%**
education (primary)	-0,009	-0,045	0,000	0%	0,002	-0,119	-0,000	0%
education (secondary)	0,040	0,260	0,010	9%	0,040	0,323	0,013	7%
Marital status (ref: not married)	**0,036**	**-0,089**	**-0,000**	**0%**	**0,088**	**-0,142**	**-0,009**	**-5%**
marital status (married)	0,026	0,046	0,001	1%	0,031	0,041	0,001	1%
marital status (other)	0,010	-0,135	-0,001	-1%	0,057	-0,183	-0,011	-6%
Urban (ref: rural)	**0,012**	**0,360**	**0,004**	**4%**	**0,034**	**0,320**	**0,011**	**6%**
urban	0,012	0,360	0,004	4%	0,034	0,320	0,011	6%
Parity (ref: no children)	**-0,119**	**-0,083**	**0,002**	**1%**	**0,008**	**-0,153**	**-0,002**	**-1%**
parity (1-2)	-0,054	0,019	-0,001	-1%	-0,016	-0,018	0,000	0%
parity (3-4)	-0,039	0,005	-0,000	0%	-0,003	-0,054	0,000	0%
parity (>5)	-0,026	-0,107	0,003	3%	0,027	-0,082	-0,002	-1%
Working status (ref: not working)	**0,040**	**-0,201**	**-0,008**	**-7%**	**0,041**	**-0,104**	**-0,004**	**-2%**
working status (working)	0,040	-0,201	-0,008	-7%	0,041	-0,104	-0,004	-2%
Wealth (ref: poorest)	**0,155**	**0,652**	**0,091**	**82%**	**0,328**	**0,612**	**0,161**	**88%**
wealth (poorer)	-0,007	-0,322	0,002	2%	0,000	-0,335	-0,000	0%
wealth (middle)	0,016	0,019	0,000	0%	0,040	-0,024	-0,001	-1%
wealth (richer)	0,018	0,316	0,006	5%	0,089	0,286	0,025	14%
wealth (richest)	0,129	0,638	0,082	74%	0,199	0,686	0,136	75%
Sub total			**0,10**				**0,17**	
Residual			**0,01**				**0,01**	
CC			0,111				0,182	

Table 6 Decomposition of the CC of Rwanda

Uganda	Period 1 (2006)				Period 2 (2011)			
	β	CC	Contribution	Percent contribution	β	CC	Contribution	Percent contribution
Age (ref: (20-24))	**0,354**	**-0,013**	**-0,005**	**-2%**	**0,457**	**-0,044**	**-0,008**	**-3%**
age (25-29)	0,023	0,033	0,001	0%	0,039	-0,011	-0,000	0%
age (30-34)	0,096	0,007	0,001	0%	0,129	0,032	0,004	1%
age (35-40)	0,103	-0,023	-0,002	-1%	0,142	-0,051	-0,007	-2%
age (>40)	0,132	-0,030	-0,004	-2%	0,186	-0,025	-0,005	-1%
Education (ref: no education)	**0,070**	**0,319**	**0,005**	**2%**	**-0,070**	**0,205**	**-0,030**	**-10%**
education (primary)	0,046	-0,112	-0,005	-2%	-0,008	-0,323	0,003	1%
education (secondary)	0,024	0,431	0,010	5%	-0,062	0,528	-0,033	-11%
Marital status (ref: not married)	**0,131**	**-0,121**	**-0,007**	**-3%**	**0,236**	**-0,155**	**-0,02**	**-7%**
marital status (married)	0,058	-0,139	-0,008	-4%	0,138	-0,127	-0,02	-6%
marital status (other)	0,073	0,018	0,001	1%	0,098	-0,028	-0,00	-1%
Urban (ref: rural)	**0,109**	**0,445**	**0,049**	**22%**	**0,110**	**0,578**	**0,064**	**21%**
urban	0,109	0,445	0,049	22%	0,110	0,578	0,064	21%
Parity (ref: no children)	**0,047**	**-0,078**	**0,004**	**2%**	**-0,159**	**-0,127**	**0,024**	**8%**
parity (1-2)	0,021	0,115	0,002	1%	-0,006	0,130	-0,001	0%
parity (3-4)	0,045	-0,026	-0,001	-1%	-0,050	-0,035	0,002	1%
parity (>5)	-0,019	-0,167	0,003	1%	-0,103	-0,222	0,023	8%
Working status (ref: not working)	**-0,029**	**-0,155**	**0,004**	**2%**	**0,011**	**-0,037**	**-0,000**	**0%**
working status (working)	-0,029	-0,155	0,004	2%	0,011	-0,037	-0,000	0%
Wealth (ref: poorest)	**0,467**	**0,573**	**0,202**	**90%**	**0,583**	**0,581**	**0,261**	**86%**
wealth (poorer)	0,028	-0,339	-0,009	-4%	0,014	-0,332	-0,005	-2%
wealth (middle)	0,083	-0,077	-0,006	-3%	0,079	-0,095	-0,008	-2%
wealth (richer)	0,100	0,228	0,023	10%	0,200	0,214	0,043	14%
wealth (richest)	0,256	0,761	0,195	87%	0,290	0,794	0,230	75%
Sub total			**0,253**				**0,290**	
Residual			**0,021**				**0,013**	
CC			0,274				0,303	

Table 7 Decomposition of the CC of Uganda

Senegal	Period 1 (2005)				Period 2 (2011)			
	β	CC	Contribution	Percent contribution	β	CC	Contribution	Percent contribution
Age (ref: (20-24))	**0,657**	**0,031**	**0,014**	**4%**	**0,412**	**-0,024**	**-0,003**	**-2%**
age (25-29)	0,039	-0,040	-0,002	-1%	0,024	0,010	0,000	0%
age (30-34)	0,173	0,039	0,007	5%	0,070	0,004	0,000	0%
age (35-40)	0,175	0,001	0,000	0%	0,116	-0,047	-0,005	-3%
age (>40)	0,271	0,031	0,008	6%	0,202	0,009	0,002	1%
Education (ref: no education)	**0,157**	**0,537**	**0,046**	**32%**	**0,081**	**0,524**	**0,021**	**12%**
education (primary)	0,057	0,183	0,010	7%	0,039	0,220	0,009	5%
education (secondary)	0,100	0,354	0,036	25%	0,042	0,304	0,013	7%
Marital status (ref: not married)	**-0,830**	**0,000**	**-0,000**	**0%**	**-0,018**	**-0,030**	**-0,013**	**-7%**
marital status (married)	-0,830	0,000	-0,000	0%	-0,036	0,235	-0,008	-5%
marital status (other)	0,000	-0,000	0,000	0%	0,018	-0,265	-0,005	-3%
Urban (ref: rural)	**0,065**	**0,848**	**0,055**	**39%**	**0,122**	**0,776**	**0,094**	**54%**
urban	0,065	0,848	0,055	39%	0,122	0,776	0,094	54%
Parity (ref: no children)	**0,105**	**-0,055**	**-0,010**	**-7%**	**0,137**	**-0,253**	**-0,023**	**-13%**
parity (1-2)	0,011	0,195	0,002	1%	0,009	0,089	0,001	0%
parity (3-4)	0,047	-0,019	-0,001	-1%	0,054	-0,065	-0,003	-2%
parity (>5)	0,048	-0,231	-0,011	-8%	0,074	-0,277	-0,020	-12%
Working status (ref: not working)	**0,014**	**0,122**	**0,002**	**1%**	**0,079**	**0,166**	**0,013**	**7%**
working status (working)	0,014	0,122	0,002	1%	0,079	0,166	0,013	7%
Wealth (ref: poorest)	**0,632**	**0,552**	**0,232**	**162%**	**0,227**	**0,544**	**0,083**	**47%**
wealth (poorer)	0,033	-0,321	-0,011	-7%	0,012	-0,343	-0,004	-2%
wealth (middle)	0,131	-0,125	-0,016	-11%	0,051	-0,110	-0,006	-3%
wealth (richer)	0,194	0,179	0,035	24%	0,062	0,241	0,015	9%
wealth (richest)	0,274	0,818	0,224	157%	0,102	0,756	0,077	44%
Sub total			0,345				0,170	
Residual			-0,163				0,006	
CC			0,182				0,164	

Table 8 Decomposition of the CC of Senegal (including variables marital status and working status)

Senegal	Period 1 (2005)				Period 2 (2011)			
	β	CC	Contribution	Percent contribution	β	CC	Contribution	Percent contribution
Age (ref: (20-24))	**0,689**	**-0,039**	**-0,013**	**-7%**	**0,627**	**-0,023**	**-0,004**	**-2%**
age (25-29)	0,041	0,016	0,001	0%	0,059	-0,002	-0,000	0%
age (30-34)	0,166	-0,002	-0,000	0%	0,120	0,009	0,001	1%
age (35-40)	0,208	-0,021	-0,004	-2%	0,183	-0,040	-0,007	-4%
age (>40)	0,274	-0,033	-0,009	-5%	0,266	0,010	0,003	2%
Education (ref: no education)	**0,111**	**0,574**	**0,032**	**18%**	**0,058**	**0,513**	**0,014**	**9%**
education (primary)	0,053	0,227	0,012	7%	0,037	0,220	0,008	5%
education (secondary)	0,059	0,347	0,020	11%	0,020	0,293	0,006	4%
Urban (ref: rural)	**0,031**	**0,843**	**0,026**	**14%**	**0,099**	**0,782**	**0,077**	**47%**
urban	0,031	0,843	0,026	14%	0,099	0,782	0,077	47%
Parity (ref: no children)	**0,071**	**-0,161**	**0,000**	**0%**	**-0,014**	**-0,201**	**0,001**	**1%**
parity (1-2)	0,039	0,086	0,003	2%	-0,000	-0,051	0,000	0%
parity (3-4)	0,001	-0,151	-0,000	0%	-0,007	-0,096	0,001	0%
parity (>5)	0,031	-0,096	-0,003	-2%	-0,007	-0,053	0,000	0%
Wealth (ref: poorest)	**0,370**	**0,563**	**0,131**	**72%**	**0,216**	**0,552**	**0,071**	**43%**
wealth (poorer)	0,004	-0,319	-0,001	-1%	0,009	-0,344	-0,003	-2%
wealth (middle)	0,087	-0,117	-0,010	-6%	0,058	-0,100	-0,006	-4%
wealth (richer)	0,135	0,177	0,024	13%	0,064	0,234	0,015	9%
wealth (richest)	0,145	0,823	0,119	65%	0,085	0,762	0,065	39%
Sub total			0,177				0,160	
Residual			0,005				0,004	
CC			0,182				0,164	

Table 9 Decomposition of the CC of Senegal (excluding variables marital status and working status)

Zimbabwe	Period 1 (2006)				Period 2 (2011)			
	β	CC	Contribution	Percent contribution	β	CC	Contribution	Percent contribution
Age (ref: (20-24))	**0,612**	**-0,063**	**-0,014**	**-5%**	**0,668**	**-0,038**	**-0,007**	**-3%**
age (25-29)	0,066	-0,007	-0,000	0%	0,096	-0,003	-0,000	0%
age (30-34)	0,111	-0,012	-0,001	0%	0,140	0,012	0,002	1%
age (35-40)	0,189	0,023	0,004	2%	0,174	-0,045	-0,008	-3%
age (>40)	0,246	-0,067	-0,016	-6%	0,258	-0,002	-0,000	0%
Education (ref: no education)	**0,061**	**0,104**	**0,013**	**5%**	**-0,004**	**0,059**	**0,011**	**5%**
education (primary)	0,019	-0,407	-0,008	-3%	-0,016	-0,365	0,006	3%
education (secondary)	0,042	0,512	0,021	8%	0,012	0,424	0,005	2%
Marital status (ref: not married)	**0,091**	**-0,167**	**-0,013**	**-5%**	**0,117**	**-0,174**	**-0,014**	**-6%**
marital status (married)	0,071	-0,183	-0,013	-5%	0,088	-0,153	-0,013	-6%
marital status (other)	0,019	0,016	0,000	0%	0,029	-0,021	-0,001	0%
Urban (ref: rural)	**0,047**	**0,916**	**0,043**	**15%**	**0,035**	**0,781**	**0,027**	**12%**
urban	0,047	0,916	0,043	15%	0,035	0,781	0,027	12%
Parity (ref: no children)	**0,040**	**-0,159**	**-0,004**	**-2%**	**0,165**	**-0,173**	**-0,020**	**-9%**
parity (1-2)	0,000	0,137	0,000	0%	0,015	0,106	0,002	1%
parity (3-4)	0,029	-0,055	-0,002	-1%	0,071	-0,081	-0,006	-3%
parity (>5)	0,011	-0,242	-0,003	-1%	0,080	-0,198	-0,016	-7%
Working status (ref: not working)	**0,036**	**0,177**	**0,006**	**2%**	**0,006**	**0,242**	**0,001**	**1%**
working status (working)	0,036	0,177	0,006	2%	0,006	0,242	0,001	1%
Wealth (ref: poorest)	**0,541**	**0,578**	**0,232**	**84%**	**0,684**	**0,564**	**0,222**	**97%**
wealth (poorer)	0,035	-0,321	-0,011	-4%	0,076	-0,332	-0,025	-11%
wealth (middle)	0,065	-0,100	-0,007	-2%	0,131	-0,103	-0,013	-6%
wealth (richer)	0,166	0,234	0,039	14%	0,194	0,246	0,048	21%
wealth (richest)	0,276	0,765	0,211	76%	0,283	0,753	0,213	93%
Sub total			**0,264**				**0,221**	
Residual			**0,014**	**5%**			**0,008**	**4%**
CC			0,278				0,229	

Table 10 Decomposition of the CC of Zimbabwe

Lesotho	Period 1 (2004)				Period 2 (2009)			
	β	CC	Contribution	Percent contribution	β	CC	Contribution	Percent contribution
Age (ref: (20-24))	**0,855**	**0,077**	**0,014**	**5%**	**0,563**	**0,027**	**0,004**	**2%**
age (25-29)	0,138	0,041	0,006	2%	0,070	0,004	0,000	0%
age (30-34)	0,182	0,004	0,001	0%	0,140	-0,004	-0,001	0%
age (35-40)	0,235	0,036	0,008	3%	0,169	0,055	0,009	4%
age (>40)	0,299	-0,004	-0,001	0%	0,183	-0,028	-0,005	-2%
Education (ref: no education)	**-0,108**	**0,045**	**0,008**	**3%**	**-0,196**	**0,029**	**0,031**	**12%**
education (primary)	-0,066	-0,394	0,026	9%	-0,129	-0,524	0,068	26%
education (secondary)	-0,042	0,439	-0,019	-7%	-0,067	0,554	-0,037	-14%
Marital status (ref: not married)	**-0,102**	**-0,132**	**0,007**	**2%**	**0,190**	**-0,156**	**-0,018**	**-7%**
marital status (married)	-0,034	-0,066	0,002	1%	0,146	-0,112	-0,016	-6%
marital status (other)	-0,068	-0,066	0,005	2%	0,044	-0,045	-0,002	-1%
Urban (ref: rural)	**-0,067**	**0,567**	**-0,038**	**-14%**	**-0,067**	**0,714**	**-0,048**	**-19%**
urban	-0,067	0,567	-0,038	-14%	-0,067	0,714	-0,048	-19%
Parity (ref: no children)	**0,261**	**-0,127**	**-0,013**	**-5%**	**0,110**	**-0,141**	**-0,004**	**-2%**
parity (1-2)	0,071	0,049	0,004	1%	0,035	0,140	0,005	2%
parity (3-4)	0,096	-0,001	-0,000	0%	0,054	-0,097	-0,005	-2%
parity (>5)	0,093	-0,175	-0,016	-6%	0,021	-0,184	-0,004	-2%
Working status (ref: not working)	**0,096**	**0,245**	**0,024**	**9%**	**0,060**	**0,239**	**0,014**	**6%**
working status (working)	0,096	0,245	0,024	9%	0,060	0,239	0,014	6%
Wealth (ref: poorest)	**0,714**	**0,463**	**0,263**	**95%**	**0,842**	**0,480**	**0,258**	**101%**
wealth (poorer)	0,056	-0,397	-0,022	-8%	0,133	-0,357	-0,047	-19%
wealth (middle)	0,130	-0,139	-0,018	-7%	0,130	-0,160	-0,021	-8%
wealth (richer)	0,201	0,183	0,037	13%	0,227	0,192	0,044	17%
wealth (richest)	0,327	0,817	0,267	97%	0,352	0,805	0,283	111%
Sub total			**0,264**				**0,237**	
Residual			**0,012**	**4%**			**0,018**	**7%**
CC			0,276				0,255	

Table 11 Decomposition of the CC of Lesotho

Ethiopia	Period 1 (2005)				Period 2 (2011)			
	β	CC	Contribution	Percent contribution	β	CC	Contribution	Percent contribution
Age (ref: (20-24))	**0,182**	**-0,070**	**-0,005**	**-6%**	**0,227**	**-0,095**	**-0,009**	**-6%**
age (25-29)	0,012	0,024	0,000	0%	0,021	0,020	0,000	0%
age (30-34)	0,050	-0,031	-0,002	-2%	0,052	0,006	0,000	0%
age (35-40)	0,054	-0,015	-0,001	-1%	0,061	-0,048	-0,003	-2%
age (>40)	0,065	-0,048	-0,003	-4%	0,093	-0,073	-0,007	-5%
Education (ref: no education)	**0,117**	**0,489**	**0,036**	**42%**	**0,088**	**0,517**	**0,025**	**18%**
education (primary)	0,017	0,150	0,003	3%	0,025	0,207	0,005	4%
education (secondary)	0,100	0,338	0,034	39%	0,063	0,310	0,020	14%
Marital status (ref: not married)	**0,048**	**-0,161**	**-0,006**	**-7%**	**0,072**	**-0,171**	**-0,008**	**-5%**
marital status (married)	0,036	-0,185	-0,007	-8%	0,043	-0,201	-0,009	-6%
marital status (other)	0,011	0,023	0,000	0%	0,030	0,030	0,001	1%
Urban (ref: rural)	**0,099**	**0,553**	**0,055**	**64%**	**0,032**	**0,671**	**0,022**	**15%**
urban	0,099	0,553	0,055	64%	0,032	0,671	0,022	15%
Parity (ref: no children)	**-0,019**	**-0,196**	**0,005**	**5%**	**-0,041**	**-0,203**	**0,008**	**6%**
parity (1-2)	0,002	0,060	0,000	0%	-0,004	0,102	-0,000	0%
parity (3-4)	0,002	-0,058	-0,000	0%	-0,007	-0,016	0,000	0%
parity (>5)	-0,023	-0,199	0,005	5%	-0,030	-0,288	0,009	6%
Working status (ref: not working)	**0,012**	**0,139**	**0,002**	**2%**	**-0,005**	**0,215**	**-0,001**	**-1%**
working status (working)	0,012	0,139	0,002	2%	-0,005	0,215	-0,001	-1%
Wealth (ref: poorest)	**0,004**	**0,615**	**-0,005**	**-6%**	**0,147**	**0,587**	**0,093**	**66%**
wealth (poorer)	0,015	-0,332	-0,005	-6%	0,011	-0,338	-0,004	-3%
wealth (middle)	-0,006	-0,036	0,000	0%	0,006	-0,065	-0,000	0%
wealth (richer)	-0,007	0,241	-0,002	-2%	0,006	0,212	0,001	1%
wealth (richest)	0,002	0,741	0,002	2%	0,123	0,777	0,096	68%
Sub total			**0,081**				**0,131**	
Residual			**0,005**	**6%**			**0,011**	**8%**
CC			0,086				0,141	

Table 12 Decomposition of the CC of Ethiopia

Malawi	Period 1 (2004)				Period 2 (2011)			
	β	CC	Contribution	Percent contribution	β	CC	Contribution	Percent contribution
Age (ref: (20-24))	**0,173**	**0,014**	**0,000**	**0%**	**0,431**	**0,031**	**0,002**	**1%**
age (25-29)	0,018	0,022	0,000	0%	0,068	0,013	0,001	0,00
age (30-34)	0,049	-0,009	-0,000	0%	0,107	0,020	0,002	0,01
age (35-40)	0,107	0,001	0,000	0%	0,107	0,020	0,002	0,01
age (>40)	0,093	-0,027	-0,003	-2%	0,149	-0,021	-0,003	-0,02
Education (ref: no education)	**0,057**	**0,296**	**0,012**	**8%**	**0,120**	**0,226**	**0,014**	**7%**
education (primary)	0,018	-0,025	-0,000	0%	0,058	-0,161	-0,009	-0,05
education (secondary)	0,039	0,322	0,013	8%	0,062	0,388	0,024	0,12
Marital status (ref: not married)	**0,077**	**-0,088**	**-0,003**	**-2%**	**0,133**	**-0,093**	**-0,006**	**-3%**
marital status (married)	0,043	0,066	0,003	2%	0,078	-0,017	-0,001	-0,01
marital status (other)	0,035	-0,154	-0,005	-3%	0,055	-0,076	-0,004	-0,02
Urban (ref: rural)	**0,016**	**0,425**	**0,007**	**4%**	**0,074**	**0,480**	**0,036**	**17%**
urban	0,016	0,425	0,007	4%	0,074	0,480	0,036	0,17
Parity (ref: no children)	**-0,006**	**-0,073**	**-0,001**	**-1%**	**0,051**	**-0,087**	**-0,002**	**-1%**
parity (1-2)	-0,011	0,066	-0,001	0%	0,021	0,066	0,001	0,01
parity (3-4)	-0,000	-0,016	0,000	0%	0,005	-0,004	-0,000	-0,00
parity (>5)	0,005	-0,123	-0,001	0%	0,024	-0,149	-0,004	-0,02
Working status (ref: not working)	**0,005**	**-0,109**	**-0,001**	**0%**	**0,005**	**-0,001**	**-0,000**	**0%**
working status (working)	0,005	-0,109	-0,001	0%	0,005	-0,001	-0,000	-0,00
Wealth (ref: poorest)	**0,220**	**0,585**	**0,132**	**85%**	**0,322**	**0,565**	**0,152**	**74%**
wealth (poorer)	-0,010	-0,352	0,004	2%	0,025	-0,366	-0,009	-0,04
wealth (middle)	0,010	-0,039	-0,000	0%	0,036	-0,055	-0,002	-0,01
wealth (richer)	0,061	0,281	0,017	11%	0,061	0,245	0,015	0,07
wealth (richest)	0,160	0,695	0,111	72%	0,199	0,741	0,148	0,72
Sub total			**0,146**				**0,196**	
Residual			**0,009**	**6%**			**0,009**	**4%**
CC			0,155				0,205	

Table 13 Decomposition of the CC of Malawi

Appendix 2 – Decomposition of change in the corrected concentration index

Decomposition of change in the CC of Rwanda								
	β (period 1)	β (period 2)	ECI (period 1)	ECI (period 2)	Δ β	Δ ECI	Δ Total Contribution	Δ Percent Contribution
Age	**-0,091**	**-0,056**	**-0,034**	**-0,065**	**0,035**	**-0,032**	**0,001**	**2%**
age (25-29)	-0,019	-0,010	0,042	-0,003	0,010	-0,046	0,001	1%
age (30-34)	-0,007	-0,003	0,021	0,001	0,004	-0,020	0,000	0%
age (35-39)	-0,024	-0,017	-0,004	-0,021	0,007	-0,017	0,000	0%
age (>40)	-0,041	-0,026	-0,093	-0,042				
Education	**0,031**	**0,042**	**0,215**	**0,204**	**0,011**	**-0,012**	**0,002**	**3%**
education (primary)	-0,009	0,002	-0,045	-0,119	0,011	-0,075	-0,001	-1%
education (secondary)	0,040	0,040	0,260	0,323	0,000	0,063	0,003	4%
Marital status	**0,036**	**0,088**	**-0,089**	**-0,142**	**0,052**	**-0,053**	**-0,009**	**-13%**
marital status (married)	0,026	0,031	0,046	0,041	0,005	-0,005	0,000	0%
marital status (other)	0,010	0,057	-0,135	-0,183	0,047	-0,048	-0,009	-13%
Urban	**0,012**	**0,034**	**0,360**	**0,320**	**0,022**	**-0,040**	**0,006**	**9%**
urban	0,012	0,034	0,360	0,320	0,022	-0,040	0,006	9%
Parity	**-0,119**	**0,008**	**-0,083**	**-0,153**	**0,126**	**-0,070**	**-0,003**	**-5%**
parity (1-2)	-0,054	-0,016	0,019	-0,018	0,037	-0,037	0,001	2%
parity (3-4)	-0,039	-0,003	0,005	-0,054	0,036	-0,059	0,000	0%
parity (>5)	-0,026	0,027	-0,107	-0,082	0,053	0,026	-0,005	-7%
Working status	**0,040**	**0,041**	**-0,201**	**-0,104**	**0,001**	**0,098**	**0,004**	**5%**
working status (working)	0,040	0,041	-0,201	-0,104	0,001	0,098	0,004	5%
Wealth	**0,155**	**0,328**	**0,652**	**0,612**	**0,172**	**-0,039**	**0,070**	**98%**
wealth (poorer)	-0,007	0,000	-0,322	-0,335	0,008	-0,013	-0,002	-3%
wealth (middle)	0,016	0,040	0,019	-0,024	0,024	-0,044	-0,001	-2%
wealth (richer)	0,018	0,089	0,316	0,286	0,071	-0,031	0,020	27%
wealth (richest)	0,129	0,199	0,638	0,686	0,070	0,048	0,054	75%
Residual							**0,001**	**1%**
Δ CC							0.072	

Table 14 Decomposition of change in the CC of Rwanda

Decomposition of change in the CC of Uganda								
	β (period 1)	β (period 2)	ECI (period 1)	ECI (period 2)	Δ β	Δ ECI	Δ Total Contribution	Δ Percent Contribution
Age	**0.354**	**0.496**	**-0.013**	**-0.055**	**0.142**	**-0.042**	**-0.003**	**-11%**
age (25-29)	0.023	0.039	0.033	-0.011	0.016	-0.044	-0.001	-4%
age (30-34)	0.096	0.129	0.007	0.032	0.033	0.025	0.003	12%
age (35-39)	0.103	0.142	-0.023	-0.051	0.039	-0.028	-0.005	-17%
age (>40)	0.132	0.186	-0.030	-0.025	0.054	0.005	-0.001	-2%
Education	**0.070**	**-0.070**	**0.319**	**0.205**	**-0.140**	**-0.114**	**-0.035**	**-122%**
education (primary)	0.046	-0.008	-0.112	-0.323	-0.054	-0.211	0.008	27%
education (secondary)	0.024	-0.062	0.431	0.528	-0.086	0.097	-0.043	-149%
Marital status	**0.131**	**0.236**	**-0.121**	**-0.155**	**0.105**	**-0.034**	**-0.014**	**-47%**
marital status (married)	0.058	0.138	-0.139	-0.127	0.080	0.012	-0.009	-33%
marital status (other)	0.073	0.098	0.018	-0.028	0.025	-0.046	-0.004	-14%
Urban	**0.109**	**0.110**	**0.445**	**0.578**	**0.001**	**0.133**	**0.015**	**52%**
urban	0.109	0.110	0.445	0.578	0.001	0.133	0.015	52%
Parity	**0.047**	**-0.159**	**-0.078**	**-0.127**	**-0.206**	**-0.049**	**0.019**	**67%**
parity (1-2)	0.021	-0.006	0.115	0.130	-0.027	0.015	-0.003	-11%
parity (3-4)	0.045	-0.050	-0.026	-0.035	-0.095	-0.009	0.003	10%
parity (>5)	-0.019	-0.103	-0.167	-0.222	-0.084	-0.055	0.020	68%
Working status	**-0.029**	**0.011**	**-0.155**	**-0.037**	**0.040**	**0.118**	**-0.005**	**-17%**
working status (working)	-0.029	0.011	-0.155	-0.037	0.040	0.118	-0.005	-17%
Wealth	**0.467**	**0.583**	**0.573**	**0.581**	**0.116**	**0.008**	**0.059**	**204%**
wealth (poorer)	0.028	0.014	-0.339	-0.332	-0.014	0.007	0.005	17%
wealth (middle)	0.083	0.079	-0.077	-0.095	-0.004	-0.018	-0.001	-4%
wealth (richer)	0.100	0.200	0.228	0.214	0.100	-0.014	0.020	69%
wealth (richest)	0.256	0.290	0.761	0.794	0.034	0.033	0.035	122%
Residual							-0.008	-26%
Δ CC							0.029	

Table 15 Decomposition of change in the CC of Uganda

Decomposition of change in the CC of Senegal								
	β (period 1)	β (period 2)	ECI (period 1)	ECI (period 2)	Δ β	Δ ECI	Δ Total Contribution	Δ Percent Contribution
Age	**0,689**	**0,627**	**-0,039**	**-0,023**	**-0,06**	**0,02**	**0,01**	**-52%**
age (25-29)	0,041	0,059	0,016	-0,002	0,02	-0,02	0,00	4%
age (30-34)	0,166	0,120	-0,002	0,009	-0,05	0,01	0,00	-8%
age (35-39)	0,208	0,183	-0,021	-0,040	-0,03	-0,02	0,00	16%
age (>40)	0,274	0,266	-0,033	0,010	-0,01	0,04	0,01	-65%
Education	**0,111**	**0,058**	**0,574**	**0,513**	-0,05	-0,06	**-0,02**	**101%**
education (primary)	0,053	0,037	0,227	0,220	-0,02	-0,01	0,00	21%
education (secondary)	0,059	0,020	0,347	0,293	-0,04	-0,05	-0,01	80%
Urban	**0,031**	**0,099**	**0,843**	**0,782**	0,07	-0,06	**0,05**	**-286%**
urban	0,031	0,099	0,843	0,782	0,07	-0,06	0,05	-286%
Parity	**0,071**	**-0,014**	**-0,161**	**-0,201**	-0,09	-0,04	**0,00**	**-4%**
parity (1-2)	0,039	0,000	0,086	-0,051	-0,04	-0,14	0,00	19%
parity (3-4)	0,001	-0,007	-0,151	-0,096	-0,01	0,05	0,00	-4%
parity (>5)	0,031	-0,007	-0,096	-0,053	-0,04	0,04	0,00	-18%
Wealth	**0,370**	**0,216**	**0,563**	**0,552**	-0,15	-0,01	**-0,06**	**335%**
wealth (poorer)	0,004	0,009	-0,319	-0,344	0,00	-0,02	0,00	9%
wealth (middle)	0,087	0,058	-0,117	-0,100	-0,03	0,02	0,00	-24%
wealth (richer)	0,135	0,064	0,177	0,234	-0,07	0,06	-0,01	49%
wealth (richest)	0,145	0,085	0,823	0,762	-0,06	-0,06	-0,05	302%
Residual							**-0,001**	**5%**
							-0,018	

Table 16 Decomposition of change in the CC of Senegal

Decomposition of change in the CC of Zimbabwe								
	β (period 1)	β (period 2)	ECI (period 1)	ECI (period 2)	Δ β	Δ ECI	Δ Total Contribution	Δ Percent Contribution
Age	**0.612**	**0.668**	**-0.063**	**-0.038**	**0.055**	**0.025**	**0.007**	**-14%**
age (25-29)	0.066	0.096	-0.007	-0.003	0.029	0.005	0.000	0%
age (30-34)	0.111	0.140	-0.012	0.012	0.029	0.024	0.003	-6%
age (35-39)	0.189	0.174	0.023	-0.045	-0.015	-0.069	-0.012	25%
age (>40)	0.246	0.258	-0.067	-0.002	0.012	0.065	0.016	-33%
Education	**0.061**	**-0.004**	**0.104**	**0.059**	**-0.065**	**-0.046**	**-0.002**	**5%**
education (primary)	0.019	-0.016	-0.407	-0.365	-0.036	0.042	0.014	-28%
education (secondary)	0.042	0.012	0.512	0.424	-0.030	-0.088	-0.016	33%
Marital status	**0.091**	**0.117**	**-0.167**	**-0.174**	**0.026**	**-0.007**	**-0.001**	**3%**
marital status (married)	0.071	0.088	-0.183	-0.153	0.017	0.031	0.000	1%
marital status (other)	0.019	0.029	0.016	-0.021	0.009	-0.038	-0.001	2%
Urban	**0.047**	**0.035**	**0.916**	**0.781**	**-0.012**	**-0.135**	**-0.016**	**32%**
urban	0.047	0.035	0.916	0.781	-0.012	-0.135	-0.016	32%
Parity	**0.040**	**0.165**	**-0.159**	**-0.173**	**0.126**	**-0.014**	**-0.016**	**32%**
parity (1-2)	0.000	0.015	0.137	0.106	0.015	-0.031	0.002	-3%
parity (3-4)	0.029	0.071	-0.055	-0.081	0.042	-0.026	-0.004	9%
parity (>5)	0.011	0.080	-0.242	-0.198	0.069	0.044	-0.013	27%
Working status	**0.036**	**0.006**	**0.177**	**0.242**	**-0.030**	**0.065**	**-0.005**	**10%**
working status (working)	0.036	0.006	0.177	0.242	-0.030	0.065	-0.005	10%
Wealth	**0.541**	**0.684**	**0.578**	**0.564**	**0.143**	**-0.014**	**-0.010**	**21%**
wealth (poorer)	0.035	0.076	-0.321	-0.332	0.041	-0.011	-0.014	29%
wealth (middle)	0.065	0.131	-0.100	-0.103	0.066	-0.002	-0.007	14%
wealth (richer)	0.166	0.194	0.234	0.246	0.028	0.012	0.009	-18%
wealth (richest)	0.276	0.283	0.765	0.753	0.007	-0.013	0.002	-4%
Residual							-0.006	12%
							-0.049	

Table 17 Decomposition of change in the CC of Zimbabwe

Decomposition of change in the CC of Lesotho								
	β (period 1)	β (period 2)	ECI (period 1)	ECI (period 2)	Δ β	Δ ECI	Δ Total Contribution	Δ Percent Contribution
Age	**0,855**	**0,563**	**0,077**	**0,027**	**-0,292**	**-0,049**	**-0.010**	**46%**
age (25-29)	0,138	0,070	0,041	0,004	-0,068	-0,037	-0.005	26%
age (30-34)	0,182	0,140	0,004	-0,004	-0,042	-0,008	-0.001	6%
age (35-39)	0,235	0,169	0,036	0,055	-0,066	0,019	0.001	-4%
age (>40)	0,299	0,183	-0,004	-0,028	-0,116	-0,024	-0.004	19%
Education	**-0,108**	**-0,196**	**0,045**	**0,029**	**-0,087**	**-0,016**	**0.023**	**-110%**
education (primary)	-0,066	-0,129	-0,394	-0,524	-0,063	-0,131	0.042	-198%
education (secondary)	-0,042	-0,067	0,439	0,554	-0,025	0,115	-0.018	88%
Marital status	**-0,102**	**0,190**	**-0,132**	**-0,156**	**0,292**	**-0,024**	**-0.025**	**119%**
marital status (married)	-0,034	0,146	-0,066	-0,112	0,180	-0,046	-0.019	88%
marital status (other)	-0,068	0,044	-0,066	-0,045	0,112	0,022	-0.006	31%
Urban	**-0,067**	**-0,067**	**0,567**	**0,714**	**0,000**	**0,147**	**-0.010**	**46%**
urban	-0,067	-0,067	0,567	0,714	0,000	0,147	-0.010	46%
Parity	**0,261**	**0,110**	**-0,127**	**-0,141**	**-0,151**	**-0,014**	**0.009**	**-41%**
parity (1-2)	0,071	0,035	0,049	0,140	-0,037	0,091	0.001	-6%
parity (3-4)	0,096	0,054	-0,001	-0,097	-0,042	-0,096	-0.005	25%
parity (>5)	0,093	0,021	-0,175	-0,184	-0,072	-0,009	0.012	-59%
Working status	**0,096**	**0,060**	**0,245**	**0,239**	**-0,036**	**-0,006**	**-0.009**	**43%**
working status (working)	0,096	0,060	0,245	0,239	-0,036	-0,006	-0.009	43%
Wealth	**0,714**	**0,842**	**0,463**	**0,480**	**0,128**	**0,017**	**-0.005**	**24%**
wealth (poorer)	0,056	0,133	-0,397	-0,357	0,077	0,041	-0.025	120%
wealth (middle)	0,130	0,130	-0,139	-0,160	0,000	-0,021	-0.003	13%
wealth (richer)	0,201	0,227	0,183	0,192	0,026	0,010	0.007	-33%
wealth (richest)	0,327	0,352	0,817	0,805	0,025	-0,013	0.016	-76%
Residual							0.006	-27%
CC							-0.021	

Table 18 Decomposition of change in the CC of Lesotho

Decomposition of change in the CC of Ethiopia								
	β (period 1)	β (period 2)	ECI (period 1)	ECI (period 2)	Δ β	Δ ECI	Δ Total Contribution	Δ Percent Contribution
Age	**0,182**	**0,227**	**-0,070**	**-0,095**	**0,046**	**-0,025**	**-0.004**	**-7%**
age (25-29)	0,012	0,021	0,024	0,020	0,009	-0,004	0.000	0%
age (30-34)	0,050	0,052	-0,031	0,006	0,002	0,037	0.002	3%
age (35-39)	0,054	0,061	-0,015	-0,048	0,007	-0,033	-0.002	-4%
age (>40)	0,065	0,093	-0,048	-0,073	0,028	-0,025	-0.004	-7%
Education	**0,117**	**0,088**	**0,489**	**0,517**	**-0,029**	**0,029**	**-0.012**	**-21%**
education (primary)	0,017	0,025	0,150	0,207	0,008	0,057	0.003	5%
education (secondary)	0,100	0,063	0,338	0,310	-0,036	-0,028	-0.014	-26%
Marital status	**0,048**	**0,072**	**-0,161**	**-0,171**	**0,025**	**-0,010**	**-0.001**	**-2%**
marital status (married)	0,036	0,043	-0,185	-0,201	0,006	-0,016	-0.002	-3%
marital status (other)	0,011	0,030	0,023	0,030	0,018	0,006	0.001	1%
Urban	**0,099**	**0,032**	**0,553**	**0,671**	**-0,067**	**0,118**	**-0.033**	**-60%**
urban	0,099	0,032	0,553	0,671	-0,067	0,118	-0.033	-60%
Parity	**-0,019**	**-0,041**	**-0,196**	**-0,203**	**-0,022**	**-0,006**	**0.004**	**7%**
parity (1-2)	0,002	-0,004	0,060	0,102	-0,006	0,042	-0.001	-1%
parity (3-4)	0,002	-0,007	-0,058	-0,016	-0,010	0,042	0.000	0%
parity (>5)	-0,023	-0,030	-0,199	-0,288	-0,007	-0,090	0.004	7%
Working status	**0,012**	**-0,005**	**0,139**	**0,215**	**-0,017**	**0,076**	**-0.003**	**-5%**
working status (working)	0,012	-0,005	0,139	0,215	-0,017	0,076	-0.003	-5%
Wealth	**0,004**	**0,147**	**0,615**	**0,587**	**0,143**	**-0,028**	**0.098**	**178%**
wealth (poorer)	0,015	0,011	-0,332	-0,338	-0,004	-0,006	0.001	2%
wealth (middle)	-0,006	0,006	-0,036	-0,065	0,013	-0,029	-0.001	-1%
wealth (richer)	-0,007	0,006	0,241	0,212	0,014	-0,029	0.003	6%
wealth (richest)	0,002	0,123	0,741	0,777	0,121	0,036	0.094	171%
Residual							0.005	10%
							0.055	

Table 19 Decomposition of change in the CC of Ethiopia

Decomposition of change in the CC of Malawi								
	β (period 1)	β (period 2)	ECI (period 1)	ECI (period 2)	Δ β	Δ ECI	Δ Total Contribution	Δ Percent Contribution
Age	**0,267**	**0,431**	**-0,013**	**0,031**	**0,165**	**0,045**	**0,005**	**9%**
age (25-29)	0,018	0,068	0,022	0,013	0,050	-0,009	0,000	1%
age (30-34)	0,049	0,107	-0,009	0,020	0,059	0,029	0,003	5%
age (35-39)	0,107	0,107	0,001	0,020	-0,001	0,019	0,002	4%
age (>40)	0,093	0,149	-0,027	-0,021	0,056	0,006	-0,001	-1%
Education	**0,057**	**0,120**	**0,296**	**0,226**	**0,063**	**-0,070**	**0,002**	**5%**
education (primary)	0,018	0,058	-0,025	-0,161	0,040	-0,136	-0,009	-18%
education (secondary)	0,039	0,062	0,322	0,388	0,023	0,066	0,011	23%
Marital status	**0,077**	**0,133**	**-0,088**	**-0,093**	**0,056**	**-0,005**	**-0,003**	**-6%**
marital status (married)	0,043	0,078	0,066	-0,017	0,035	-0,083	-0,004	-8%
marital status (other)	0,035	0,055	-0,154	-0,076	0,021	0,078	0,001	2%
Urban	**0,016**	**0,074**	**0,425**	**0,480**	**0,059**	**0,055**	**0,029**	**57%**
urban	0,016	0,074	0,425	0,480	0,059	0,055	0,029	57%
Parity	**-0,006**	**0,051**	**-0,073**	**-0,087**	**0,057**	**-0,013**	**-0,001**	**-2%**
parity (1-2)	-0,011	0,021	0,066	0,066	0,033	0,000	0,002	4%
parity (3-4)	0,000	0,005	-0,016	-0,004	0,005	0,012	-0,000	0%
parity (>5)	0,005	0,024	-0,123	-0,149	0,019	-0,026	-0,003	-6%
Working status	**0,005**	**0,005**	**-0,109**	**-0,001**	**0,000**	**0,107**	**0,001**	**1%**
working status (working)	0,005	0,005	-0,109	-0,001	0,000	0,107	0,001	1%
Wealth	**0,220**	**0,322**	**0,585**	**0,565**	**0,101**	**-0,020**	**0,020**	**40%**
wealth (poorer)	-0,010	0,025	-0,352	-0,366	0,035	-0,014	-0,013	-25%
wealth (middle)	0,010	0,036	-0,039	-0,055	0,026	-0,016	-0,002	-3%
wealth (richer)	0,061	0,061	0,281	0,245	0,000	-0,036	-0,002	-4%
wealth (richest)	0,160	0,199	0,695	0,741	0,039	0,046	0,037	73%
Residual							-0,002	-4%
Δ CC							0,050	

Table 20 Decomposition of change in the CC of Malawi