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DETERMINANTS AND IMPACT OF HOUSEHOLD'S OUT-OF–POCKET HEALTH CARE EXPENDITURE IN SUDAN: EVIDENCE FROM URBAN AND RURAL POPULATION

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Abstract

This study examines the determinants of out of pocket (OOP) health expenditures and the factors that associated with the risk of catastrophic health expenditure in Sudan. It also investigates the effect of OOP health expenditure on poverty incidence in the country. The study uses the National Baseline Household Survey (NBHS) data, 2009, for national, urban and rural levels of population. To strengthen the insight of findings, the analysis of OOP expenditure is also executed for different income groups. The results show that factors such as household's income, incidence of disease, education, household size, number of household's members over 65 years and below 5 years old are the most important factors affecting health expenditures. The results also indicate that the number of elderly member and children and household belonging to the lowest income quintiles are the most significant variables that increase the risk of incurring catastrophic health expenditures. In addition, the results reveal that a household with catastrophic health expenditure tends to reduce its budget share allocated to education, food and other items. Moreover, the empirical results indicate that health expenditure pushes a considerable portion of Sudanese households into poverty, thus, increases poverty rates in the country. Finally, the paper ends with some recommendations that aim at assisting policymakers in designing an appropriate health system strategy to protect households against the risk of OOP health expenditures and to reduce impoverishment effect when become catastrophic.

JEL Classification: I1, I3

Keywords: Out of pocket, health expenditure, catastrophic health expenditure, poverty, Sudan

ملخص

تبحث هذه الدراسة محددات النفقات الصحية من خارج الجيب والعوامل المرتبطة بخطر الانفاق الصحي الكارثي في السودان. كما أنه يحقق في تأثير الإنفاق الصحي على الصحة العامة على انتشار الفقر في البلاد. وتستخدم الدراسة بيانات المسح الوطني للأسر المعيشية، لعام 2009، على المستويات الوطنية والحضرية والريفية للسكان. ولتعزيز رؤية النتائج، يتم أيضا تحليل نفقات التشغيل الخارجي لمختلف فئات الدخل. وتظهر النتائج أن عوامل مثل دخل الأسرة، ومعدل الإصابة بالأمراض، والتعليم، وحجم الأسرة المعيشية، وعدد أفراد الأسرة المعيشية الذين تزيد أعمارهم على 65 سنة وأقل من 5 سنوات، هي أهم العوامل التي تؤثر على النفقات الصحية. وتشير النتائج أيضا إلى أن عدد كبار السن والأطفال والأسر المعيشية المنتمين إلى الشريحة الدنيا من الدخل هي أهم المتغيرات التي تزيد من خطر تكبد نفقات صحية كارثية. وبالإضافة إلى ذلك، تكشف النتائج أن الأسرة المعيشية التي تعاني من إنفاق صحي كارثي تميل إلى تخفيض حصتها في الميزانية المخصصة للتعليم والغذاء والمواد الأخرى. وعلاوة على ذلك، تشير النتائج التجريبية إلى أن الإنفاق على الصحة يدفع جزءا كبيرا من الأسر السودانية إلى الفقر، مما يزيد معدلات الفقر في البلاد. وأخيرا، ينتهي البحث ببعض التوصيات التي تهدف إلى مساعدة واضعي السياسات في تصميم استراتيجية نظام صحي مناسبة لحماية ألسر من مخاطر اإلنفاق على الصحة العامة والحد من تأثير الفقر عندما تصبح كارثية.

1. Background

In the last three decades, the world per capita income has increased significantly, giving hope for further improvements in the standards of living and healthiness of population all over the world. This progress, however, were associated with parallel increases in household's out-of-pocket (OOP) health expenditures. Out-of-pocket health expenditure becomes representing a high burden on household income, particularly in developing countries, where poverty and illness are widespread problems. It is widely acknowledged that in light of ineffective health financing system and lack of social protection networks in poor countries, OOP health spending by households would continue to be very high representing a large portion of total household's budget (Xu et al., 2003 and Van Doorslaer et al, 2006).

Taking into consideration the rapid growth in health expenses, it becomes difficult for most of the nations to accomplish the desirable progress in achieving the development goals. The image becomes darker when health expenses exceed a certain limit. In this case, health expenditures eat significant part from household's resources and, as a consequence, considered catastrophic. Expenditures of such magnitudes may force household's member(s) to cut their expenditures on goods and services that are necessary for human survival. This in turns undermine household's welfare and exerts negative effects on productivity and growth, thus, makes large portion of population vulnerable to poverty.

In Sudan, the provision of healthcare service has been affected by economic and social transformations that the country undergone in the last three decades. For instance, the adoption of economic liberalization and the introduction of free market policies in early 1990s have contributed greatly in reducing public spending on health services. Since then, the size of private investment in healthcare sector has expanded. Government issued hundreds of licenses to the private agents to provide health and medical services for the public. The key aim behind implementing these austerity policies was to reduce government's administrative spending on health and also to raise the quality of health and medical services provided. However, the stylized facts on health situation reveal the opposite. By reducing the participation of government in providing healthcare services, the households' expenditure has gone up although part of health services, especially in emergencies, is still delivered through public sector. In response to increase in households' health spending as well as to increase the number of households provided by healthcare, the government has launched community-based health insurance schemes. However, despite these ambitious extensive efforts, the out-of-pocket expenditure remains skyrocketing, particularly in rural areas where most of population lives in poverty, lacks health infrastructures and have no access to health insurance programs. Moreover, the existing insurance schemes are not universal coverage programs and, thus, leave household bears a great part of cost of the medical services.

Additionally, the demographic composition of the population of Sudan exacerbates the problems resulting from health spending and, therefore, intensifies its economic and social effects on households. It is well known that the majority of Sudan population (about 66%) resides in rural areas that lacking the adequate health infrastructures. What is more, the high portion of population in rural areas casts negative consequences on health performance in the country. Rural residents, also, have high propensity to be comparatively less educated making health services utilization very low compared to urban areas. In addition, the lack of urbanization indicates not only a deficiency in the provision of physical health infrastructures, but also unsatisfactory intangible infrastructures such as, health culture and health consciousness. The obvious implications of these variations in distributing and utilizing health services between rural and urban areas are expected to create significant differences in both determinants and consequences of health spending on the households. On the whole, for a developing country like Sudan, the presence of such implications would obstruct the path of economic development in the country.

Against this background, many questions can be raised in accordance with aims of this study, including: What are the decisive determinants of the households' health expenditures in Sudan? What are the key factors that are likely push Sudanese households to undertake a catastrophic health spending? What are the consequences of health expenditures on poverty incidence among Sudanese households? To what extent could the determinants and the impact of the households' healthcare expenditures vary among rural and urban areas as well as across different income categories?

The principal aim of this study is to understand the determinants and impact of households' health expenditures in Sudan. Specifically, the study aims at:

1. Identifying the determinants of households' health expenditures in Sudan.
2. Detecting the factors that contribute in making health spending catastrophic for Sudanese households.
3. Investigating whether the determinants of general health expenditure and catastrophic expenditure varies among different social group (i.e. urban versus rural population) as well as across different income categories.
4. Analyzing the impact of catastrophic health expenditure on households' economic status (i.e. poverty and impoverishment).

Regarding the importance and policy relevance, the empirical investigation to be undertaken by this study is considered crucial for several reasons. First, the paper would contribute to the existing literature and policy formulation for the case of Sudan, as to the best of our knowledge there are no empirical studies have been done to explore this issue using Sudanese data. Accordingly, studying the determinants and impact of OOP health expenditures is fundamental to provide evidence that can be used to formulate policies targeting planning and reforming health system and health provision in Sudan. Second, understanding the impact of catastrophic health spending on Sudanese households may provide policymakers and key stakeholders (i.e. national and international NGOs) with the basis to be more strategic in addressing healthcare provision. This would assist in mitigating the negative consequences of health's financial catastrophe. Third, the study would explore the feasibility and the contribution of health insurance schemes adopted in last decades in raising health performance in the country. This may help in assuring the strong points in the existing health insurance system and, concurrently, avoid its shortcomings. Specifically, appraising the role of health insurance in protecting people would contribute greatly in paving ways to realize the desirable universal coverage. Fourth, by identifying the factors affecting risk of health expenditure among different areas (i.e. urban and rural) and income groups, the study would lay the foundation stone in designing effective health programs to protect the disadvantaged groups. Fifth, this study is timely and relevant if taken in the context of transformations of Sudanese healthcare policies in recent decades. Therefore, the results of the paper will be significant in guiding an appropriate strategy aiming at reducing the risk resulting from incurring catastrophic health expenditures. Furthermore, the findings of this study would help to ensure better access to health service and a higher degree of financial protection for low-income groups against the negative impacts of illness.

This paper is organized into seven sections. Section one represents an introduction, while Section two gives some stylized facts on health system in Sudan. Section three outlines and critically assesses the theoretical and empirical literature on the determinants of health spending in general and catastrophic expenditure in particular. Section four sketches the conceptual framework of the study and Section five discusses the data and research methodology. Section six presents the empirical results and discussions. Section seven ends with a conclusion and possible ways forwards.

2. The Situation of Healthiness and Health System in Sudan

2.1 Sudan's healthiness: An overview

Sudan gained its independence from Anglo-Egyptian rule and achieved the full national sovereignty on its territory in the 1st of January 1956. The colonial rule, which extended for more than half of a century (1898-1956), left the country with an economy lacking unbalanced development, diversity and not possesses the minimum prerequisites for self-sustaining growth. This economy depends heavily on agriculture which contributes by, approximately, over 30 % of its GDP and 70% of exports, and provides job opportunities for 80% of the labor force. According to 2015's World Bank report, Sudan has a total population of 39,350,274 out of which 33.62% are live in urban areas (World Bank, 2015). The country's population grows at an annual rate of 2.15% and the total fertility rate is 4.42% (World Bank, 2015). The age structure of the population has remained predominately young, with 42% of the population under the age of 15 years and over half (55.5%) falling within the age group of 15 to 65 years. According to International Monetary Fund (IMF), unemployment in the country is also remains extremely high. On average, about 25 % of the labor force in Sudan was unemployed in 2000-2014 (IMF, 2014). Due to frequent droughts, natural disasters, wars and political instability, the country's economic performance, especially the part concerned with achieving decent livelihood, remains stagnant and largely fluctuated. The GDP per capita did not witness a great leap that could assist, if maintained for long time period, in elevating the living standards of the people. The significant dependence on agriculture, which depends largely on the rains fall, made the country's economy vulnerable to great fluctuations with regard to output, productivity and employment. The exposure to such tough circumstances in acquiring livelihood has led to widespread of poverty among the population, particularly those who live in marginalized areas. Nationally, an estimated of 46.5% of Sudan population is living below the poverty line. According to 2015's Human Development Report, Sudan's human development index (HDI) value for 2014 was 0.48 which situates the country in the low human development category.

Given this situation of lacking the pillars of economic development, the country has been engulfed in the vicious circle of poverty in which poor healthiness of the population represents one of its strongest chains. Alternatively stated, during last five decades health services' provision in Sudan remained extremely weak, causing health status of the population to drop to one of poorest health status regionally and globally. The life expectancy at birth is 62, the maternal mortality ratio is estimated at 325 per hundred thousand of population, the infant mortality rate at 48 per thousand live births, and child mortality rate at 72 per thousand (World Bank, 2014). At the present, these figures are considerably less than each Middle East and North Africa countries (MENA). Surprisingly, in the first year followed the independence, the performance of Sudan in terms of health indicators was pretty well compared to its counterparts from MENA countries. For instance, the country registered the lowest average infant mortality rates during the period from 1962 to 1967. Specifically, the average infant mortality rate per thousand of birth in Sudan was, approximately, 100, while in the same period it recorded 107, 146, 181, 159, and 148 for United Arab Emirates, Turkey, Egypt, Tunisia and Algeria, respectively (see Table 1). However, at the ends of the last decade of twentieth century and the beginning of twenty-one century, the picture has inverted. Sudan's health indicators performance has significantly deteriorated or at least remains without major improvements compared to these countries. It is worth mentioning that due the continuous exposure to crises such as civil wars, drought and other natural upheavals, most of the successive governments ignored the health services' matters and focused mainly on the other issues such as the continuous initiation of public and military mobilization. These matters had contributed a lot in cutting government's health expenditures making health sector underfunded and fall short than satisfying the needs from healthcare by the majority of population.

In the same vein, other developmental and health indicators could also mirror the relative and absolute decline in country's wellbeing. Table 2 shows that in the first half of the decade followed the country's independence, during that period, the life expectancy at birth was higher than the relevant regional groups such as MENA and Sub-Saharan African countries (SSA). As can be indicated from the table, the life expectancy at birth for Sudanese was 49 years while it accounts for 47.8 and 41 for those who lived in MENA and SSA, respectively. This occurred although the GDP per capita in Sudan was far less than the average achieved by countries comprising these regions. During the second half of the 1960s, the GDP per capita was, on average, US$1272.1, US$ 814.9 and US$ 3895.9 for MENA, SSA and world, respectively. Remarkably, this was much higher than the average GDP per capita reported by Sudan during the same period (US$ 455.2)[1].

In the second half of 70s, life expectancy in Sudan became 53.4 while that for MENA countries was 56. However, in the 1970s, MENA region reached an average life expectancy rate of 56 years which is 2 years higher than that achieved by Sudan. Similarly, in the 1960s, the Sudanese individual was expected to live 8 years more than his SSA counterparts and lesser 5 years compared to worldwide longevity. However, in 1970s the gap in life expectancy between SSA has dropped to 7 years while it widened to 8 years between Sudan and world.

In the 1980s, the life expectancy for Sudan became less than that of MENA region and world by 6.2 and 10.5 years, respectively. It is worth to mention that in the 1980s the country has exposed to one of the disastrous famines in the history. Poverty, malnutrition, unhealthy diet, and increase in traffic accidents had contributed substantially to this moderate life expectancy at birth. In 1990s, driven by implementation of liberalization policies, the gap in life expectancy at birth between Sudan on one hand and MENA and World on the other grew to 11 and 10 years, respectively. This dark image was corrected by the improvements in the living standards brought by the presence of oil at the end of 1990s and 2000s. In the first decade of 21st century, led by these positive developments, the life expectancy in Sudan registered an average of 60 years which is 5 years higher than the levels observed in the first half of 1990s.

Whatever the case was, the life expectancy at birth of Sudanese people in the first half of the second decade of 21st century is better than the rates observed in 1960s. Between these two periods, it grew by 31% indicating that a typical Sudanese citizen is expected to live, approximately, extra 13 years compared to those who lived 1960s. However, this is considered quite low when it puts in regional contexts. For instance, the growth rates in life expectancy between 1960s and the 2013 registered 55% and 44.5 % in MENA and SSA, respectively. Surprisingly, through the six decades under comparison, the real GDP per capita for SSA grew by 43.7% while the GDP per capita for Sudan grew by 89%. This signifies the initial difference between GDP per capita in SSA and Sudan in 1960s.

The deteriorations in healthiness performance in Sudan can be also documented by the successes in improving health of children. Specifically, in terms of under five years mortality rate, Sudan has performed well compared to other MENA countries at the mid of past century. In 1960, 178.4 out of each thousand Sudanese children did not live for more than five years old (see Figure 2). Apart from Jordon, for the same period, the figure below shows that under-five

[1] This good performance in life expectancy at birth has many interpretations. Firstly, during that period, the living environment was clean and free from pollution. The population was scattered across different regions in very low intensity. This help in creating clean and healthy environment that fits human being living conditions and, thus, many diseases were prevented. In contrast, the opposite may take place now. Currently, people in Sudan are squeezed in small houses mostly lack healthiness's key attributes such as sanitation, running waters supplies, clean air and open spaces. The negative outcome of such contaminated environment is manifested in the outbreak of diseases such as hypertension and respiratory illnesses. Second, most of the food and nutrients were obtained directly from natural sources that were free from toxic ingredients. Specifically, in addition to toxic-free vegetables and fruits, most of the food sources were embodied in meat and milk obtained from animals that were grazing in nature.

mortalities per thousand children were 204.6, 249, 312.8, 267.8 and 246.3 for U.A.E, Turkey, Egypt, Tunisia and Algeria, respectively. However, although this indicator kept on declining since the mid of 20th century for countries under comparison, Sudan has been left behind.

2.2 The current health status of the population

The health status of the population in Sudan is highly overwhelmed by the incidence of communicable diseases. The parasitic infections represent the main causes of morbidity and mortality among population. These diseases include malaria, tuberculosis, diarrhea diseases and respiratory infections. A large part of Sudan's land is malarious and 75% of the population is at risk of malaria infection. Therefore, the malaria endemic remains a major public health problem in Sudan and occupies the highest episodes among different population groups. It represents the first leading cause of hospital admissions and a leading cause of inpatient deaths in the country. The SHHUES's survey showed that the prevalence of malaria was fairly high among both rural and urban population. As reported in Table 3, 3.9% and 4.4% of surveyed population had malaria (SHHUES, 2009).

As delivered by HHUES 2009's report, the incidence of respiratory disease constitutes nearly 3.8% of cute disease episodes in the country (see Table 3). This percent was quite higher among urban as well as among the segment of lowest income of population. The prevalence of this incidence reaches 4.6% and 4.8% for urban population and population situating in the fifth quintile, respectively. Other types of cute disease episodes such as diarrheal, minor injury, ophthalmic, abscess, viral HB, and typhoid fever are moderate and don't diverge from the level existing in other countries (see Table 3).

According to World Health Organization, due to increases in across borders movement from neighboring countries with higher AIDS epidemic, HIV/AIDS situation in Sudan is anticipated to get worse (WHO, 2010). According to the WHO reports, around 2% of population who their age is ranged between 15 and 49 years old are living with HIV/AID. In the absence of a concrete health infrastructures and facilities, AIDS has become shaping one of the top causes of mortalities among population. However, the country is still classified among the low epidemic about diseases prevalence. The provision of healthcare (both diagnosis and drugs) for the population who infected is tackled by government. For unreported cases, the costs of medication are shouldered by individuals and thus contribute in rising health expenditures to catastrophic levels. Moreover, AIDS epidemic is expected to raise the infected households' morbidity and absenteeism in the workplace and, thus, lead to low productivity. The end result is that AIDS's infected individuals are expected to be fired from jobs due to low productivity. This in turn led to significant decreases in the incomes generated by this group of population making any health expenditures undertaken by them catastrophic.

In addition to the heavy burden of communicable acute disease, Sudan is also experiencing a hurriedly growing burden of chronic diseases. Of these, hypertension, diabetes, asthma, cardiovascular diseases, UTI, psychiatric diseases, malnutrition and cancer have been among the top causes of hospitalization and deaths in the country. However, as shown in Table 4, the incidence of hypertension and diabetes diseases is considered higher among both urban and fifth quintile population.

In general, the performance of Sudan in terms of health is considered very poor to the extent that it endangers the future of the majority of population. This poor performance in healthiness levels may attribute to many reasons. First, the majority of the country's population are uneducated and illiterates, particularly in rural areas where the average of literacy rate is very low. The implication is that the lack of education penetration among people has led and still leads to direct and indirect weakness in health delivery and utilization. The high illiteracy rates inhibited individuals from acquiring knowledge and education on health's matters blocking a large segment of the country's population to recognize the benefits of modern medical inputs

such as vaccinating children and other chronic diseases. Besides, the lowest level of educational attainment makes the prevailing knowledge and cultures oppose the utilization of the existing healthcare sources. Uneducated people have tendencies to deal with health matters via metaphysic interpretations. Therefore, instead of admitting to hospitals to see physicians, illiterate people prefer to visit traditional healers. Such behavior in tackling health matters, although reduces health expenditures in the short run, however; in the long run it may contribute in rising health spending to catastrophic levels. Second, health services provision in Sudan is unevenly distributed across both geographical strata and income' groups. The abovementioned stylized facts tell that both poor and rural population bears the heaviest burden of underprivileged healthcare provision in the country. According to WHO, 70% of the total healthcare cadres are concentrated in capital city Khartoum serving 20% of country population (WHO, 2010). In the end, the low level of incomes, accompanied with probable morbidity, is expected deepen the catastrophic health spending among unfortunate population.

Third, Sudan has a weak and fragile health infrastructure. This weakness places limits on health delivery and utilization. Health cadres and facilities are inadequate compared to the size of population. People travel long distance in order to access health services. This derives a large segment of population to spend significant proportion from their income on health services provision. Fourth, health administration in Sudan focuses on the curative side of health provision. It turned blind eyes to the preventive healthiness in particular the aspects that related to hygiene, nutrition and health behavior. For that reason, about 80% of diseases are attributable to preventable conditions that are related to personal and environmental hygiene, infectious diseases and malnutrition. Fifth, the disappointing overall economic performance of the country overshadowed the pathway of the progress in both health services provision and health outcome indicators. As outlined above, this can be indicated by the performance of healthiness indicators such as longevity, infant mortality, maternal mortality, and morbidity rates. The real GDP per capita does not cover the basic needs of majority of population indicating great definiteness in food intakes and malnutrition. Moreover, the lack of supply in hard currencies, due to economic problem, obstructs importing medical inputs such as drugs, lifesaving treatment and sanitation supplements.

2.3. Financing health services in Sudan: An Overview

Administratively, following the introduction of federalism in Sudan in 1993, heath system became disintegrated into a three-tier system. These three tires include the administration at federal level represented by federal ministry of health (FMOH), at state level embodied in the ministries of health (SMOH) in the 17th states comprising the country, and the health authorities' units at locality levels (176 localities). Other sub-health systems work side by side with official health system on providing health services to a considerable number of populations. These include health insurance schemes, armed forces, Sudan's police, universities, civil society organizations, philanthropic bodies, private providers and nongovernmental organizations in conflict-affected areas. All sub-health systems are governed by the regulations decided by SMOH as well as the legalizations and regulations on the state level.

The federal ministry of health (FMOH) sketches the health policies on the national levels. It frames the major plans and strategies, gives guidance on health matters, evaluates the performance of health system at national and states' levels, trains the medical practitioners and cadres and creates and promotes relationships with external health related bodies. In a complete agreement with federal ministry's plan, the States' ministries of health (SMOHs) coin their own plans, strategies, training programmes to implement the policies proposed. The health authorities at a locality level implement the national and states policies and provide the primary health care (PHC) services to the population. The public insurance scheme which provides health services coverage for public employees is run by the national health insurance fund. In

the same way, the private insurance schemes are involved in health services provision. It worth to mention these schemes have its own healthcare facilities including hospitals, clinic and pharmacies.

In terms of finance, the British colonizer inherited Sudan a tax-based health system in which the state plays the role of the exclusive healthcare provider. According to that system, healthcare services and medicine supplies were delivered free of charge since the colonial era and till the beginning of 1990s decade (WHO, 2006). However, after the implementation of Structural Adjustment Program (SAP), the government began its sudden withdrawal from healthcare services provision. The austerity measures adopted in 1992 comprehend all sectors including health, the sector in which public spending has witnessed significant decreases. To fill the gap in fund resulting from these policies, the government introduced the user fees system in 1992. In line with this system, users are requested to pay fees in order to utilize health facilities. However, the primary health consultation, which usually provided by primary health care units (PHCU), dispensaries and dressing stations was provided without charges (Mohamed, 2007).

Because of deficiency in health infrastructures, the end result of implementing of SAP measures on health sector was a great drop in healthcare provision and delivery. The public hospitals that are previously fully funded by government became places for waiting deaths instead of health recovery. To search for better pay and good work conditions, the medical cadres and practitioners left the health sector to gulf countries, or in best cases they switch to private sector providers. The rest of cadres who fail to escape public health sector became unmotivated and don't abide to perform their assigned jobs. This absent of motives resulted in growing numbers of medical mistakes by medical practitioners. For all these reasons and others, healthcare services provision became unevenly distributed throughout the country. Thus, the excellent health providers and practitioners became concentrated in the largest cities and urban centers leaving rural areas with poor and understaffed health facilities. For instance, 70% of the total healthcare cadres are concentrated in capital city Khartoum serving 20% of country population.

To mitigate the negative outcomes associated with SAP policies on health provision the government launched the community-based health insurance schemes. This scheme began by establishing the General Corporation for Health Insurance in 1994. In 2003, the act of General Corporation for Health Insurance was amended, and the corporation was transformed to the National Health Insurance Fund (NHIF). By introducing these new amendments, the admission to health insurance services became open to all population categories based on a unified subscription ratio of 4% for employees and workers with regular salaries and flat rate subscription according to actuarial estimates for those with irregular incomes. However, despite the expansion in health insurance, maintaining universal coverage for all population remain unattainable target and the portion of population that suffer from health expenditures has gone up. Thus, the out-of-pocket expenditures climb sharply particularly in rural areas where most of population lives in poverty and don't possess regular jobs. As shown by Baloul and Dahlui (2014), compared to 25.3% of the urban dwellers, 16.9% of the rural population are insured.

It is worth to mention that the public health spending, which is supposed to bear the lion share in health costs, is accounted for a negligible proportion from the country's GDP. The upper part of Table 5 shows that public health expenditures in Sudan and a sample of comparable counties in the period followed the adoption of SAP policies.

As can be professed from the table above, compared to the six of MENA countries reported, Sudan has smallest public health spending from its GDP. Specifically, the public health expenditure (% of GDP) remained rotating around 1% and in best cases it became closer to 2%

throughout 1995-2013. During 2007-2010, it progressed positively to the rate of 2.22% indicating the expansion in infrastructural development fruited from oil. However, towards the end of the first decade of 2000s, which witnessed the secession of the South Sudan and the cutting back of oil's revenues, the economy showed such weak previous growth rates that had been observed in 1990s' decade. The growth in GDP diminished back to -1.97 and - 2.21% in 2011 and 2012, respectively (World Bank, 2014). As a consequence, health spending as a percentage of GDP dropped significantly to an annual average of 1.64 during 2011-2013.

Yet, if public health spending as a percentage of total government expenditures is considered, Sudan is found to be in a good position compared to the countries under comparison (the middle part of Table 5). This similarity between Sudan and these countries, however, should be interpreted carefully. This is so because the large portion of health spending from government's budget may cover expenditures that are directed to administrative aspects of health rather than real healthcare items. This can be indicated by the growing rates in private health spending as a percentage of GDP in the last two decades. In addition, the high proportion of public health spending from government expenditures may reflect the small size of government's budget compared to the country under comparison.

According to Table 6, the health spending by private sector grew rapidly during the period from 1995 to 2013 (approximately, 57%) indicating the significant gap resulting from the absence of government expenditures. This fact is supported by the figures on out-of-pocket health (OPP) expenditure[2] as brought in Table 7 below. As can be read from the table, the OPP expenditure represents, approximately, 95% of total private health expenditures in Sudan. This signifies a life-threatening pattern of spending on health provision. In other words, the high proportion of the OOP point to the catastrophic nature of health expenditures to the extent that it became a real threat to the welfare of citizens.

The presence of such catastrophic spending on health can be further supported by the stylized facts displayed in Figure 3 which provides the percentage distribution of the source of funds for health services in Sudan as reported by 2009's HHUES. As the figure illustrates, 80% of the Sudanese households' funds to encounter health spending is sourced from their own resources. Furthermore, 10% of health expenditures were covered by debt and selling assets, 6% were covered by health insurance and 3% were sourced from relatives. This reality connotes the exposure of the majority of population to the heaviest burdens of catastrophic health spending.

As a natural outcome of the quick withdrawal of government from the health sector, health expenditure by population has considerably gone up and most importantly became catastrophic. Table 8 illustrates the patterns of catastrophic health expenditures by households' type of residence and economic status as reported by NBHS. As can be read from the table, 49.96% out of total households surveyed spend up to 10% from their monthly incomes on health spending which lies in the range of catastrophic thresholds as described in the established literatures. Narrowing down, the incidence of catastrophic spending varies according to the type of residence and economic status of the households. For instance, households with 10% catastrophic spending threshold among those who reside in rural areas are higher compared to those who live in urban areas. Specifically, 52.57% of the rural households surveyed in 2009 are found to spend a proportion of 10% from their total monthly incomes on health services facilities. Little bit lower than rural population, 44.16% of urban households surveyed are found to spend 10% of their monthly incomes on health services provision. By the same token,

[2] Out of pocket expenditure is any direct outlay by households, including gratuities and in-kind payments, to health practitioners and suppliers of pharmaceuticals, therapeutic appliances, and other goods and services whose primary intent is to contribute to the restoration or enhancement of the health status of individuals or population groups. It is a part of private health expenditure (World Bank, 2014).

the rural households preserve a higher level of health expenditures when 20% threshold of health spending is considered. According to Table 8, corresponding to 20.54% of urban households, 28.8 % of rural households devoted 20% from their monthly incomes to health elements.

Additionally, the statistics in Table 8 demonstrates that even with decreases in ability to pay, as measured by the positions of households across income quintiles, the patterns of undertaking catastrophic health spending don't differ considerably across these income groups. As shown in the table, apart from the households in the first income quintile, 50% of the households are found to incur a 10% catastrophic payment on medical expenditures. However, across different quintiles roughly 26 % and 9% of households in the rest of four quintiles are found to be spending, respectively, 20% and 40% out of their total monthly income on health's matters. This reflects the severity of the burdens of catastrophic expenditures that Sudanese households face at the current stage of development.

According to 2009's SHHS, the odds of incurring catastrophic spending are also differ by educational status and geographical strata. Compared to households with secondary, post-secondary and university levels of education, households with primary education were found to demonstrate a higher level of catastrophic spending at all thresholds. As can be seen from Table 9, away from university education, the catastrophic health expenditures incurred decreases as the levels of education attainment for underlying household increases. For example, 49.61% of the households with primary education spend 10% of their total monthly income on health provision. In the same vein, 25.13% and 6.78% of the households with primary educational attainment spend, respectively, 20% and 40% from their total monthly incomes on health's needs. Similar to households with primary education and different from secondary and post-secondary education, households holding tertiary education tend to spend higher proportion from their total monthly incomes on health matters. Moreover, as reported in Table 9, households from different regions incurred similar catastrophic health spending across different thresholds. However, the central state lean towards spending slightly higher on health services compared to the rest of the states.

Furthermore, the severity of undertaking catastrophic health spending can be demonstrated by Figure 4 which exhibits the different mechanisms adopted by the households to cope with catastrophic health expenditures. With 45% of the population living below the $1.25 a day, poverty line in Sudan, payments for health services in the form of catastrophic health expenditure are likely to be widely spread among households. In order to cope with these catastrophic expenditures, the Sudanese households pursue a variety of coping strategies. According to 2009's HHUES, these strategies include buying part of treatment, performing extra work, cutting down other expenditures, saving, selling assets, borrowing money from others, resort to charities and Zakat and getting help from relatives These coping mechanisms have been utilized to maintain the whole or significant parts of health services. Buying part of recommended treatment was found to be the predominant coping strategy. Twenty-one per cent of the households have financed their healthcare expenditures by borrowing money from others. The figure also shows that 19% of the households cope with catastrophic health spending by reducing expenditures on other living items. These may include expenditures on food, education and housing.

Summing up, Sudan's progress on the health front is extremely poor to the extent that makes it impossible to accomplish any real economic development. The healthiness of the population is one of the pillars by which the progression in human development can be measured and judged. The improvements in healthiness performance represent an advance step in defeating the three enemies of humanities namely, poverty, disease and illiteracy. The slowest progress in improving healthiness in Sudan, however, is expected to curb the country in the vicious

circle of poverty. This is because the deterioration in healthiness would push the population, whose commonly poor, to spend catastrophically on health services. This negative effect pertaining to catastrophic health spending would not stop only in pushing households into poverty; rather it exceeds that to impede them from seeking health services when they need it (WHO, 2016).

Accordingly, the factors that could contribute in deciding the patterns of health spending by Sudanese households need to be investigated and analyzed. This would help greatly in framing the suitable policies and strategies to diminish the incidence of catastrophic health spending. Moreover, recognizing the role of health spending on population's livelihood by mean of its contribution in deepening the problem of poverty and impoverishment is considered tremendously crucial. It assists policymakers in preparing for any action toward defeating poverty as well as its negative consequences.

3. Literature Review

Studying the determinants and impact of health expenditures in general and catastrophic health expenditures in particular captured the attention of a great number of researchers. This is so because such health expenditures, if incurred in larger amounts, will become catastrophic and, therefore, shrinks the household's budget share devoted to purchase other necessities. In other words, the continuous pressures on the household's budget, due to the vulnerability to high health spending, can lead to impoverishment and, thus, force large portion of population to be caught permanently in poverty trap. As stated previously, this study aims at achieving three main objectives: (1) to investigate the determinants of health expenditures by Sudanese households; (2) to inspect the factors that make this health spending to be a catastrophic phenomenon, and (3) to examine the impact of incurring such health expenditures on households' poverty status. In this section we review the related literature in a manner that serves in achieving these mentioned objectives. Given this concern, the relevant literature on the issues discussed can be broken down into three main segments depending on the perspective from which health spending has been viewed. The first segment focuses on the empirical studies that investigate the factors that influence the general health expenditures, while the second centers on mapping out the reasons that push household's health spending to go beyond the normal limit and, as a consequence, put it into financial catastrophe. The third segment of the studies considers the consequences of financial catastrophe on the underlying households. However, these three segments are overlap with each other to the extent that it becomes difficult to sketch a clear demarcation line between them. The overlapping area springs results from the fact that the vulnerability to higher health expenditures by a certain household would cause financial catastrophes and, as a result, push it in poverty and impoverishment.

Concerning the first segment of literature, several empirical studies have shown that incurring higher health expenditures depends largely on a multiplicity of factors including, economic and health status of the household, individual characteristics of the household and the nature of the accessible health system. To begin with, the role of households' economic status has been studied by numerous papers. Specifically, most of these papers advocate the existence of positive association between (OOP) health expenditures and the performance of a variety of household's economic status indicators such ability to pay, per capita income, employment and bad climatic condition such as drought (Chaudhuri and Roy, 2008 and Lechtenfeld and Lohmann, 2014).

Similarly, the importance of the nature of health system in deciding the level of health expenses has also led scholars to pay special attention to the availability of health insurance coverage as a critical determinant for health spending. The prediction is that by paying on behalf of insured, health insurance removes health services' user fees and, thus, provides protection against expenditures incurred by individuals and households. (Jowett et al., 2003; Chu et al., 2005;

Spaan et al., 2012; Wirtz et al., 2012; Brown et al., 2014). Nevertheless, it is less asserted that enrollment in health insurance actually restrain households from incurring spending. In this regard, some authors documented that the contribution of health insurance in reducing health expenditures depends largely on the household's economic position. Specifically, those authors indicated that health insurance do well in reducing richest population's out-of-pocket health payments (Sepehri, 2011). In the extreme part of spectrum, some studies suggest that, compared to the disadvantaged groups, health insurance doesn't preserve its presupposed role in mitigating increases in out-of-pocket of expenditures (Wagstaff et al., 2009; Fink et al., 2013; Liu et al., 2014). Moreover, several studies highlight the negative role of health insurance in decreasing the burden of health expenses shouldered by household's elderly member(s) (Sulku and Bernard, 2009).

Regarding the second segment of literature, the scholars examining the determinants of health expenditures always differentiate between the normal or moderate and catastrophic spending on health. According to this categorization, health expenditures turn out to be catastrophic after exceeding a certain limit or thresholds. Similar to the normal health expenditures, factors belong to the household's economic status; health status and social status are accounted as the key determinants for financial catastrophe. In particular, factors such as healthcare services utilization, low capacity to pay, poorness, lack of health insurance coverage and fees levied at government health facilities are found to be causing financial catastrophe (Xu et al., 2003; Xu et al., 2006 Gotsadze et al., 2009 and Rahman et al., 2013). However, the researchers' agreement on the role of these factors in deciding the depth and the magnitudes of catastrophe is not decisive. According to the authors proponing this argument, the financial catastrophe will increase with the level of per capita income, as it increases the opportunities for households to obtain high quality healthcare services (Su et al., 2006; O'donnell et al., 2008, Yardim et al., 2010). On other hand, some authors argue that the probability of poorest households to expose to the catastrophic expenditures is higher than that of the richest households (Rahman et al., 2013).

As concluded above, the implementation of health insurance lightens the burden of health spending and thus exercises positive role in caring the vulnerability to financial catastrophe. Many researchers confirm that expanding health insurance coverage represents one of the decisive factors in protecting people from facing financial catastrophe that imposed by OOP health spending (Kavosi et al., 2012; Akinkugbe, 2012; Devadasan et al., 2007, and Somkotra and Lagrada, 2009). Of course, as outlined for the causes of general health spending, many conditions limit the ability of health insurance in reducing the costs incurred for healthcare provision (e.g. less schooling, degree of urbanization, etc.). Agreeing with this argument, some researchers note that the contribution of health insurance in dropping financial catastrophe decreases significantly for the households with elderly member(s), having a member with a chronic illness or disability and having a member who experienced hospitalization. Surprisingly, some studies reversed this argument indicating that health insurance has nothing to do in mitigating financial catastrophe. Based on Zambian household level data, Ekman (2007) investigates the effect of health insurance in explaining catastrophic health expenditures in Zambia. His results show that health insurance coverage doesn't shield households from the risk of catastrophic payments.

Moreover, the existing literature emphasizes that the out-of-pocket expenditures can be also attributed to causes relatable to households' health status. The argument is as follows: the presence of chronic diseases pushes household to spend continuously on medical services and, thus, generates financial catastrophe. In an empirical sense, the positive influences of health status on households' health catastrophic expenditures have been acknowledged by a host of scholars (Su et al., 2006; Abegunde and Stanciole, 2008; Somkotra and Lagrada, 2009; Yardim et al., 2010 and Li et al., 2012; Kronenberg and Barros, 2014; Saito et al., 2014; Desai et al.,

2014 and Baloul and Dahlui, 2014). In the same vein, researchers examining the determinants of health expenditures suggest that both the level and the depth of catastrophic spending can be also influenced by the geographical distribution of the population among rural and urban areas. Within this framework, most of the findings point out that, compared to the urban households, rural households are more likely to face more financial catastrophe (Okunade, 1985; Sun et al., 2009; Yardim et al., 2010; Li et al., 2010 and Knaul et al., 2011). Okunade (1985), for instance, utilizes data on budget survey data for a group of African countries to study households' income elasticity for wide range of items including health spending. Among countries studied, the results demonstrate that health expenditures incurred by rural and semi-rural households in Sudan are found to be income inelastic. This implies that any decreases in poor households' incomes would raise their vulnerability to the catastrophic risks.

Finally, the rapid growth in spending related to the ill-health and its huge magnitudes in many countries have sparked several empirical studies dealing with the consequences of health expenditures. In tackling this issue, numerous studies did not limit the analysis to test the determinants of catastrophic spending only, but go beyond that to detect the implications resulting from these expenses on the well-being of households. A large body of literature confirms that the presence of catastrophic health expenditures can push households into poverty and impoverishment (Damme et al., 2004; Van Doorslaer et al., 2006; McIntyre et al., 2006; Chuma and Maina, 2012; Li et al., 2012; Shahrawat and Rao, 2012; Van et al., 2013 and Awiti, 2014). However, some authors note that the households' vulnerability to financial catastrophe would depend mostly on that household's poverty status. In other words, the poverty deepening impact of OOP payments was higher among the households who categorized as poor (Damme et al., 2004; McIntyre et al., 2006; Shahrawat and Rao, 2012 and Chuma and Maina (2012). In the same vein, some studies have asserted that households with higher out of pocket expenditures could devote more resources to cover these expenditures at the expense of non-health basic items (Russel, 1996; Wagstaff, 2007; Kim and Yang, 2011, and Wang and Hsiao, 2006). Looked at differently, due to ill health, households would miss not only the expenses undertaken to recover healthiness, but also foregone the earnings scarified during hospitalization and thus contracts welfare spending.

A different topic, but strongly relevant, is the analysis of the ill health's impacts on household's consumption. Following this train of analysis, Wang et al. (2006) show that ill health and catastrophic medical expenditures diminishes household’s investment in human and physical capital for farm production as well as it cut consumption related to human well-being. Narrowing down, the extent to which expenditures on a single endemic disease could cause impoverishment among households has received considerable attention in the current literatures (Laxminarayan, 2004; Somi et al., 2007; Curado and de Souza, 2014, and Ilunga-Ilunga and Dramaix, 2015). Nur (1993), for instance, utilizes longitudinal data collected from household heads from farming population to compare the financial and economic costs of malaria attack to that of a combination of other illness episodes on households in five malaria holo-endemic rural communities in Gezira region in Sudan. The findings show that the cost of mitigating malaria illness amounted for 49.87% of curative healthcare costs undertaken by households. Specifically, the expenditures on Malaria treatments cost each household roughly US$ 1.84 per month and US$2.60 per month if associated by other diseases. Furthermore, the author concludes that if expenditures on malaria and other diseases are lumped together they will capture 7.03% from the household's monthly average income.

What seems amply clear and obvious from the above discussion is that although the outcomes on the determinants of the financial catastrophe and its impacts on households are very homogenous. However, the levels of generalization based on these findings remain considerably low. This occurs due to several reasons. First, the social and economic settings of societies vary across different countries and households. Thus, health seeking behavior of these

households and, accordingly, the determinants of incurring health expenditures are, to large extent, society and households' contexts which don't allows us to draw definitive conclusions for most of the factors. The most robust empirical results are found to be related to economic and health status of household, which appears to be a fundamental precondition for incurring both normal and catastrophic health spending. In a country like Sudan, where the traditional values and believes are dominant, households' health seeking behavior is governed by many factors. These include factors such as, the availability of traditional healers (i.e. religious healer, alternative medicine practitioners and fortunetellers), the societal attitudinal behaviors towards patients as well as individuals' health seeking behavior. It is worth to mention that the health services brought by traditional health services providers are expected to enjoy high competitiveness among household, in particular the poorer ones and, thus, restrict their enrolment in health insurance program. This in turn may lower the insurance fund pooled from the public and, therefore, it may shrink the overall insurance coverage. Moreover, since majority of Sudanese population are rotating closely to poverty line, the slight increases in health expenditures would push households into catastrophe and, consequently, poverty and impoverishments. Second, the above-mentioned studies don't arrive to a comprehensive consensus regarding the magnitudes and the depth of the impacts resulting from financial catastrophe on the underlying household. Such mixed nature of the results casts a great doubt on the accurate effects of health spending on poor country like Sudan.

Hence, a country-by-country study of the determinants and impact of catastrophic expenditures on the household's economic status will be able to clarify this relationship and, consequently, be able to address issues relating to the role of health expenditures in policies pertain to poverty reduction.

4. Conceptual Framework

The theoretical framework of this study is constructed based on demand for healthcare theory, which is pioneered by Becker (1965) and has been extended by Grossman (1972), and Rosenzweig and Schultz (1982). The key assumption of this theory is that each household maximizes utility whose main arguments include: consumption of non-health items, health-related items and heath items as follows:

$$U = U(Y, X, H) \quad (1)$$

Where U stands for utility, X is non-health good, Y is a health-related items such as fruit, and H is health status of household. We assume that $U_Y > 0, U_X > 0, U_H > 0$; $U_{YY} < 0, U_{XX} < 0, U_{HH} < 0$. The heath of household is affected by the level of Y goods, as well as market production inputs Z. Hence, the household's health production function which is included in equation (1) can be written in equation (2) below:

$$H = f(Y, Z, \mu) \quad (2)$$

Thus, the household production is a function of health-related goods(Y), health production inputs(Z),such as medical care services; and the component of the health due to genetic endowments, environmental factors and other components that not influenced by preferences (μ).

Therefore, household maximizes the utility function subject to the budget constraint given as

$$I = P_x X + P_y Y + P_z Z \quad (3)$$

WhereP_x, P_y, and P_z are prices of non-health good, health related goods and health services, respectively, and I represents the total income available to household.

The problem here is to maximize the objective function (equation 1) subject to the budget and health production function constrains. Hence, the maximization problem can be set up in the Lagrangian function as follows:

$$L = U(X, Y, H) + \left[\lambda_1(I - (P_x X - P_y Y - P_z Z) + \lambda_2 H - f(Y, Z, \mu)\right] \quad (4)$$

The task facing the household is to simultaneously choose the amount of non-health goods, health related goods and health production inputs so as to maximize utility. Taking the first order conditions and jointly solving the equations yields the demand equations for these three goods as functions of prices and income.

$$X = D_x(P_x, P_y, P_z, I, \mu) \quad (5)$$

$$Y = D_Y(P_x, P_y, P_z, I, \mu) \quad (6)$$

$$Z = D_Z(P_x, P_y, P_z, I, \mu) \quad (7)$$

Normally, the system of equations (5)-(7) should be estimated simultaneously; however, since our interest is to examine the expenditure on health goods, we focus on equation (7). The dependent variable Z is a measure of health production inputs, which is in our study stand for health expenditure to be affected by the prices of the above mentioned three goods and income. In addition, there are other some important exogenous factors which have impacts on health expenditure such as, household socio-economic and demographic characteristics.

5. Research Methodology

5.1 Models' specifications

Based on the conceptual framework developed in the previous section in addition to the existing literature, the model specification for the determinants of households' health expenditure in Sudan (i.e. linear version of equation 7) can be expressed as follows:

$$Z_i = \alpha + \beta H_i + \gamma E_i + \lambda D_i + \delta L_i + \mu_i \quad (8)$$

Where Z is the dependent variable, which is the binary variable, takes the value of one if the household reported a positive health expenditure and zero otherwise. This variable indicates whether household experiences positive health expenditure and captures its demand for health service as well as it serves as a proxy for health seeking behavior. Following our theoretical framework and beside the existing literature (e.g. Grossman (1972), Parker and Wang (1997) and Su et al (2006)), the dependent variable is related to a set of explanatory variables including a vector of health status of household (H), household's socio-economic characteristics (E), demographic characteristics (D) and location characteristics (L). Specifically, the health status variables include morbidity and availability of health insurance, while household's socio-economic characteristics consist of income, total assets, education and employment status. The household's demographic characteristics include factors such as, the size of the household, number of children and adults among households' members, gender and age of household's head. Finally, the location characteristics deliver the impact of locational status (i.e. urban/rural) and distance on the demand for health services. The definition and measurement of the variables used in the analysis are presented in Table 10 in the empirical results section.

According to the empirical literature, the morbidity rate is expected to have a positive impact on health expenditure, since using such service leads household to spend more on healthcare. The effect of household's income is expected to be positive, as increase in income enables household to seek more and high-quality healthcare for their members. The level of education attainment of household' head is expected to have positive impact on health expenditure. This is because highly educated head of household tends to invest in the healthiness of his/her members, hence pays much higher on high quality and expensive healthcare compared to the less educated head of the household. The effect of age of the head of household is expected to

be positive as elder head is more likely to suffer from chronic diseases, and therefore spend more on health compared to young one. The effect of wage employment is expected to be negative as households' heads engaging in wage employment either in private or public sectors have health insurance. Hence, those tend to spend less on healthcare compared to self-employed household head who works mainly in informal sector and they do not have insurance. The variable of wage employment is used as a proxy for health insurance, since NBHS does not contain any explicit information about household's enrolment in health insurance schemes.

Moreover, the coefficient of household size is expected to have positive effect on health expenditure, since a large household is more likely to have high morbidity rate and more health spending. The effect of number of children (less than 5 years) and elders (more than 65 years) is expected to be positive, as household member of such ages tends to expose to diseases and disability. The effect of number of room, which used to deliver the impact of affluence, wealth and sanitation, is expected to be positive. In particular, households have more rooms are expected to be well-off and hence spend more on healthcare services. The impact of urbanization would be positive as households residing in urban area tend to spend more in healthcare compared to those who live in rural areas. Residing in the regions that far from Khartoum is expected to have positive impact on health spending, as these regions lack effective healthcare and preventive health systems, hence households living in these regions is more likely to spend more on healthcare compared to those residing in Khartoum. Finally, the effect of distance is expected to be positive, as households residing far in areas from the hospitals and health centers will pay more on transportations reaching healthcare services' centers.

In line with this study's objectives, the second equation is designed to model the determinants of households' catastrophic health expenditure. Following the lead of previous studies (e.g. Berki, 1986, Wyszewianski, 1986 and O'Donnell and Doorslaer, 2005), the catastrophic health expenditure is defined according to three threshold levels, 10%, 20% and 40% of total nonfood household's expenditures. We follow (Wagstaff and van Doorslaer, 2003) in using household's nonfood expenditures as an indicator for household's capacity to pay. Thus, the share of health expenditure in non-food expenditure (Catex) will be derived as follows:

$$Catex = \frac{hex}{nfex} \ldots \quad (9)$$

Where, *Catex* is the share of health expenditure in non-food expenditure, *hex* is the average household monthly expenditure on health; *nfex* is the average of household monthly non-food expenditures. Thus, the model pertaining to determinants of catastrophic expenditure can be expressed as follows:

$$Catex_i = \alpha + \beta H_i + \gamma E_i + \lambda D_i + \delta L_i + \mu_i \quad (10)$$

Where *Catex* is the dependent variable which is a dummy variable takes the value of one if the household experiences catastrophic health expenditure (i.e. the health expenditure exceeds the thresholds levels) and zero otherwise. The explanatory variables affecting catastrophic expenditure are identical to the factors that influencing health expenditure in equation (8). Thus, the variables' definitions and explanations remain as demarcated before.

Third, the study will examine the effect of catastrophic health expenditure on household's welfare. In this regard, the focus will be directed to the impact of Catex on three aspects of household's welfare indicators namely, education expenditure, food expenditure and expenditures on other necessary items. The study uses simple model for this purpose, which can be described as follows:

$$W_{ji} = \alpha + \beta catex_i \mu_i \quad (11)$$

Where W_{ji} is non-health expenditure (i.e. education, food and other expenditures incurred by the households (other than health expenditure). The independent variable (catex) is the catastrophic health expenditure.

5.2. Measuring the impoverishment effects of OOP health expenditure

To investigate the impoverishing effect of OOP healthcare expenditures on household's economic situation, we examine the poverty impact of health spending. Indeed, catastrophic payments may disturb the living standards due to large OOP payments for healthcare, which may push households into poverty or deepening their existing poverty (Xu et al., 2003; van Doorslaer et al., 2006; Wagstaff and van Doorslaer, 2006). The impoverishment resulting from OOP occurs when households who are considered to be non-poor (average consumption above the national poverty line) are pushed into poverty after incurring payments for healthcare (average consumption after payment for healthcare is below the national poverty line). To measure the impoverishment effect of OOP, we use two measures of poverty: the poverty headcount and the poverty gap. While the former measures the number of households living below the poverty line as a percentage of total households, the poverty gap measures the depth of poverty or the amount by which poor households fall short of reaching the poverty line.

To establish an analytical framework for analyzing the impoverishment impact of OOP, this study borrows heavily from the model developed by Wagstaff and van Doorslaer (2003). Here, we assume that z_{pov}^{pre} be the pre-payment poverty line (i.e. before the occurrence of health spending) and x_i be individual *i*'s pre-payment income. We define P_i^{pre}=1 if $x_i<z_{pov}^{pre}$. Then the pre-payment poverty headcount is equal to:

$$H_{pov}^{pre} = \frac{1}{N}\sum_{i=1}^{N} P_i^{pre} = \mu_{Ppre} \quad (12)$$

Where N represents the sample size. Denote by g_i^{pre}, the pre-payment poverty gap is equal to $x_i - z_{pov}^{pre}$ if $x_i < z_{pov}^{pre}$, and zero otherwise. The average *pre-payment poverty gap* is defined as:

$$G_{pov}^{pre} = \frac{1}{N}\sum_{i=1}^{N} g_i^{pre} = \mu_{gpre} \quad (13)$$

The normalized pre-payment poverty gap can be expressed as follows:

$$NG_{pov}^{pre} = \frac{G_{pov}^{pre}}{z_{pov}^{pre}} \quad (14)$$

And the mean positive pre-payment poverty gap is

$$MPG_{pov}^{pre} = \frac{\sum_{i=1}^{N} g_i^{pre}}{\sum_{i=1}^{N} P_i^{pre}} = \frac{\mu_{gpre}}{\mu_{Ppre}} \quad (15)$$

We therefore have

$$\mu_{gpre} = \mu_{Ppre}.\, MPG_{pov}^{pre} \quad (16)$$

In other words, the average (pre-payment) poverty gap will be equals to the fraction with a positive gap times the mean positive gap. Replacing the pre-payment poverty line z_{pov}^{pre} by the post-payment poverty line (after paying for healthcare services) z_{pov}^{post}, and all other superscripts 'pre' by the superscript 'post' gives the analogous post-payment measures.

Moreover, to measure the poverty impact of out-of-pocket payments, we follow Wagstaff and van Doorslaer (2003)'s study that has defined poverty effect as the difference between the relevant pre-payment and post-payment measures, i.e.

$$PI^{H} = H_{pov}^{post} - H_{pov}^{pre}, \quad (17)$$

$$PI^{G} = G_{pov}^{post} - G_{pov}^{pre}, \quad (18)$$

$$PI^{NG} = NG_{pov}^{post} - NG_{pov}^{pre}, \quad (19)$$

In the existing literature there are many approaches to measure poverty line, including relative and absolute measures. Following the NBHS' statistics (2009), we use the poverty line of 114 SDG per individual per month.

5.3. Data

The data for this study will be sourced from the National Baseline Households Survey (NBHS) conducted by the Central Bureau of Statistics in 2009. The survey contains data on all household' expenditures (e.g. food, education, health, utility, etc..) as well as demographic and socio-economic characteristics of households and individuals. The survey comprises 48825 individuals of 7913 households. However, information on health expenditure for each individual in household is not exist, thus, we use household as a unit of the analysis. The data reported the health expenditure of the household in past 30 days (month). The health expenditure includes data spending on medical doctoral services, medical tests, pharmaceutical products, birth delivery and hospital services. The data on health expenditure do not include in kind payments, informal payment to health worker and payments for loss of income due injuring and illness. The first screening of dataset shows that there is about 13.1% of households report zero health expenditure.

5.4. Estimation methodology

In order to estimate the models developed in the above sections, a variety of estimation methods will be used including Probit model, Heckman selection model and ordinary least square (OLS). Following Hjortseberg (2003) and Rous and Hotchkiss (2003), analyzing households' health expenditure decision that based on the sample that excludes households who did not report healthcare payments will lead to bias results. However, this biasness can be avoided if the numbers of unreported household is very low. It is worth mentioning that in developing countries, people generally seek healthcare services only when they perceive that they are ill and so many of them spend on health only when they report sick and seek medical attention (Rous and Hotchkiss, 2003). People who report sick but did not seek medical services and those who did not report sick spends zero. People who report sick and sought medical attention will spend varying amount in treating the illness. Therefore, in most cases, healthcare expenditure data is often characterized by a large cluster at zero (0) and a right skewed distribution (Karimo, 2014). In such cases the conventional OLS method is considered inadequate to obtain reliable results. Putting things together, if there are many unobserved factors that are likely to be correlated with the individual's perception of illness and healthcare expenditure, the coefficients in the healthcare expenditure equation will be biased (Rous and Hotchkiss, 2003). This study, therefore, employs the Heckman (1979) sample selection model to examine the determining factors of healthcare expenditure in Sudan.

Second, to analyze the determinants of catastrophic health expenditure model of equation (10) (i.e. presence of catastrophic health expenditure), the study will use probit as well as Heckman selection method to control for the potential selection bias that may arise when the analysis is restricted to the sample of households with positive catastrophic expenditure. Finally, equation (11) will be estimated by OLS.

Equation (8), (10) and (11) will be estimated by using different specifications. This step will be carried out for the sake of comparisons and to see the extent to which the results match the research objectives. First, a full sample pooled model including all households in urban and rural areas will be estimated. Second, to investigate whether the factors affecting health

expenditure and catastrophic expenditure are varying between rural and urban population, we estimate separate regressions for different areas (i.e. rural and urban households). Third, we estimate separate models for different income quintiles aiming to discover whether the determinants of health expenditure differing among the different income categories. Finally, we compute income elasticity for household health expenditure. This will assist in identifying the responsiveness of household's health expenditures to any minimal changes in its income and, accordingly, give accurate approximation for magnitudes of health spending.

6. Empirical Results and Discussion

This section presents the empirical results and discussions. The section is divided into three sub sections: sub-section 6.1 presents some descriptive statistics about the variables that are used in the analysis. Sub-section 6.2 reports the econometric results pertaining to the determinants of positive health expenditure and catastrophic health expenditure incurred by Sudanese households. As established previously, the estimation is run for different samples, namely the sample for whole households, urban and rural households' samples, as well as for different households' income groups. Finally, sub-section 6.3 introduces the results of the effect of OOP health expenditure on the poverty's incidence among households.

6.1. Descriptive statistics

Table 10 below describes the characteristics of the sample and the summary statistics of the variables employed in the analysis. As can be read from the table, the reported statistics indicates that the mean of total household income is SDG 852 per month. This is somewhat consistent with the national statistics as reported by NBHS (2009). However, the higher standard deviation of the total income point to the prevalence of income inequality in Sudan. The mean of heath expenditure is about SDG 59 per month, representing about 17% out of non-food expenditure. This suggests that a considerable portion of Sudanese households' budget is eaten by payments devoted to health items. The standard deviation of health expenditure is also high, indicating a great disparity among households in terms of incurring health expenditures. This outcome entails that about 73% of households have at least one of their members visit hospitals or medical centers during the month. This supports the fact that the rate of morbidity in Sudan is extremely high (Sudan Households Health Utilization and Expenditure Survey, SHHUES, 2009). The average of gender variable is very high, indicating the dominance of male in heading households. Turning to the descriptive statistics on the education variables, it can be indicated that most of the Sudanese households have a lower level of educational attainment.

As indicated in the above table, the mean of education is small, confirming the wide spread of illiteracy in Sudan, particularly among elder individuals like heads of household. This is expected to have a great influence on both health expenditures and health utilization among households. The average of household size is about six, which is consistent with the NBHS, 2009. Also, as can be seen from the table, the mean of household member aging more than 65 years is small, while the mean for those who less than 5 years is very high. This infers that the number of children in Sudanese households is very large compared to elder, advocating that Sudan hosts a large size of young cohorts. The low number of over 65 individuals be a sign of the low rate of life expectancy at birth in Sudan. This outcome lends a great support for the statistics reported by the World Bank which reports that longevity in Sudan is 63 years (WB, 2015). Moreover, as can be fairly read from the table, the average of the number of rooms is about 3 reflecting poorer housing facilities among Sudanese households. Interestingly, the mean of dummy variable (married) is high implying that most of the households' heads are married and with couples. Finally, the standard deviation of the distance to health centers is found to be very high demonstrating a great disparity in the distribution of health facilities in the country.

6.2. Econometrics results

In this sub-section we report the econometric results on the factors that push households to incur positive and catastrophic health expenditures for the whole, urban and rural samples. Furthermore, the effect of the catastrophic health expenditure on the share of the budget allocated to education, food and remaining items is analyzed.

6.2.1. Determinants of household' health expenditure

Complying with the proposed methodology and as a preliminary step, we first apply the Heckman selection method to test for the existence of the sample selection bias. In this regard, the coefficients of lamda (the selection terms) were found to be insignificant in all models, implying that our models don't suffer from the problem of sample's selection-bias. This can be explained by the few number of household with zero health expenditure, as most of households (about 87%) have incurred out of pocket health expenditure. Accordingly, we resort to the Ordinary Least Square (OLS) to estimate the models under consideration[3]. First, the results of OLS estimation of equation (8) for the whole, urban and rural sample are presented in Table 11.

As can be observed from column two, the results belong to the full sample shows that most of the variables are associated with expected signs and their magnitudes agree with prior expectations. For instance, the result reveals that the coefficient of total monthly income variable is positive and significant, indicating that a household with high income tends to spend more on healthcare services. That is an increase in household income by a 1%, elevates its health spending by 4.3%. This outcome has many interpretations. First, the strong association between households' incomes and health expenditure indicates the absence of free provision for health facilities in Sudan. Alternatively stated, due to the withdrawal of government from the areas of health, the households are pressed to cover health spending relying on their own resources. This is confirmed by the information brought up in Figure 3 which shows that 80% of health expenditures are sourced from households' own resources. Second, the nexus between income and health spending may suggest that a household with high income have a tendency to seek high quality health services compared to those with low income. This is expected in the country like Sudan in which healthcare is extremely poor and even the private health providers are not capable to supply a brilliant health services. Consequently, any increases in households' incomes are expected to shift the demand for high quality health services to the right.

Similarly, as indicated by its highest coefficient of 0.58, the impact of morbidity rate on households' health expenditure is positive and statistically significant. Since this variable reflects the probability of the presence of a disabled or ill member(s) in the households, its high coefficient may suggest that the presence of illness in the household appears to be the most important factor that influences health expenditures in Sudan. This result lends significant support to the findings brought by many previous empirical studies (e.g. Xu, 2006 and Basar, 2012).

The effect of age is found to be negative and statistically significant, implying that a household headed by elder person tends to spend less on health expenditures. This outcome can be explained by the fact that a household headed by elder person is normally contains many members who contributing to household income. Evidently, this is confirmed by the fact that relatives are accounted for 4% of the sources (See Figure 2) on which households rely on to cover their health expenditures (SHHUES, 2009). The coefficients of education are positive and statistically significant. This indicates that a household headed by high educated person

[3] We test the all models for multicollinerity problem using variance inflation factor (VIF). The mean of the VIF is found to be close to unity in all models, indicating that no multicollinerity problem.

has a high propensity to spend more on health items compared to that headed by less educated person. This may occur due to the fact that the highly educated heads seek high quality health services for their dependents.

Unpredictably, the coefficient in front of wage employment variable is found to be negative but not significant. This demonstrates that in the full sample, wage employed heads are not protected from incurring health expenditure compared to those who are self-employed. It is worth to mention that this variable is used as a proxy for insurance coverage, since most of wage employees (in public or private sectors) are insured. Alternatively stated, since health insurance is compulsory for employees in both private and public sector, the negative and insignificant sign of wage employment endorses that the current insurance scheme in Sudan has no influence in reducing OOP health expenditure. This argument can be supported by the fact that most of facilities attached to this scheme (i.e. hospitals, diagnostic centers and pharmacies …etc.) don't meet households' full needs from medical services. Moreover, under public and private insurance scheme umbrellas, the providers are not equipped with well-trained health and medical practitioners pushing households to search for high quality services.

Expectedly, the impact of household size is found to be positive and significant, suggesting that larger households tend to demand more healthcare services than smaller ones. In the same vein, the result indicates that the presence of elders (over 65 years) among households' members causes increases in OOP health expenditures as this category of population is vulnerable to diseases and health dysfunctional. This finding confirms many previous studies (e.g. Hilaire, 2014 and Basar et al, 2012). Surprisingly, the impact of number of children less than five years is found to be positive but insignificant. This result can be explained by the fact that this category receives a considerable attention from government and NGOs. Specifically, a considerable number of NGOs are concerned with the free provision of healthcare services such as vaccines and primary health care protecting households form paying more on children's healthcare.

As anticipated, the coefficient of number of rooms is found to be positive and significant. The number of rooms in which a household is accommodated can act for households' affluence and, thus, better standard of living and higher expenditures on health provision. Similarly, the impact of urban variable is found to be negative, but not significant, indicating that there is no significant difference in the patterns of health spending between households residing in urban centers and those who live in rural areas.

Interestingly, most of the coefficients of the regions are negative, entailing that households living in the states other than Khartoum, spend less on healthcare facilities. Finally, the coefficient of distance to health centers is found to be positive and statistically significant. This result suggests that a household residing in remote areas tends to allocate larger portion from their total monthly income in order to get excess to health expenditure. Undoubtedly, this is expected since population density in Sudan is very low and most of the communities are scattered in areas that are situated far away from each other. The existence of such circumstances will lead to great increases in OOP spending by the underlying households. First, the scattered and less populated characteristics don't assist both public and private sectors to establish healthcare centers in those areas and, thus, push people to spend more on transportations for health proposes. Second, the higher costs of transportation increase the medical care bills. This could happen because, due to the higher costs of transportation, households respond reluctantly to the illness of their member. Thus, in the long run the health of ill members will deteriorate significantly pushing households to incur huge OOP expenditures.

Regarding the analysis of urban and rural samples, the results in column three and four indicates that most of the coefficients are similar to the analysis of the full sample. Like the full sample

model, the coefficient of morbidity rate is found to be positive and significant in both the urban and rural models. In addition, the impact of education level is found to be positive and significant in both urban and rural samples, confirming the full sample analysis. Nevertheless, the results indicate some variations in the effect of variables that are expected to determine health expenditure among urban and rural household. For instance, unlike the rural analysis, the coefficients of age of the household's head and household income turn out to be insignificant in the urban sample. In addition, the effect of household size and number of household aged over 65 years in the urban sample are found to be insignificant. This result can be explained by the fact that the size of household in the urban areas is small and, thus, it has no significant effect on health expenditure. On the other hand, the size of households residing in rural areas is large resulting in higher demand for health services. Likewise, the numbers of household members with age more than 65 years in the urban centers are few compared to rural areas.

Likewise, similar to the outcome on the full sample, the coefficient of the number of rooms is found to be positive in urban sample, but it is not significant in the rural model. Moreover, the results reveal some urban-rural variations regarding the impact of residing in regions out of Khartoum on health spending in Sudan. For example, in the urban sample, the coefficient of Kordufan is found to be negative and significant compared to rural sample coefficient. This suggests that a household living in urban centers of Kordufan tends to spend less on health matters compared to urban Khartoum signifying great inequalities in health provision and incomes between different regions in Sudan. The insignificance of this coefficient in rural areas may occur due to the relative similarity between rural areas in terms of lifestyle, incomes as well as socioeconomic characteristics.

Little bit different from the results in the full sample, the impact of distance to health centers is found to be positive and significant in the rural sample, but it is not significant in the urban centers. As stated previously, this result suggests that the distance to health centers rises rural household spending on healthcare, as most of health providers lie in urban areas, rendering household to spend more on transportation and accommodation. This outcome indicates that health facilities are unevenly distributed between urban and rural areas. Obviously, this conclusion confirms the statistics reported in Table 10, which shows a high standard deviation for the distance variable.

6.2.2. Determinants of catastrophic health expenditure

As outlined in the methodology, to examine the factors that influence the risk that household being suffer from catastrophic health expenditure, the study uses the probit models. Specifically, as proposed in the methodology, the model of equation (10) is estimated for the three different thresholds of catastrophic expenditures, namely 10%, 20% and 40%. However, as a preliminary step, the problem selection bias is checked using Heckman test. According to this test's results, the coefficients of lamda are found to be not significant, suggesting the absence of sample selection bias. Thus, the study proceeds without worry about such a problem and estimate the proposed probit model. The results of marginal effects from this probit model are presented in Table 12 below.

Table 12 shows that there is a variation in the effects of the factors that supposed to determine catastrophic health expenditure across different thresholds. This variation can be detected in the coefficients' magnitudes and significance. Thus, focusing on one threshold value may result in inaccurate estimates and don't convey the precise importance of some variables. The results reveal that household income has a negative and significant impact on catastrophic health expenses at 10%, 20% and 40% thresholds, respectively. This result indicates that an increase in household's income reduces the likelihood of household being suffer from catastrophic health expenditure. This outcome can be explained based on two reasons. First, increased

incomes may possibly provide sufficient food that contributes greatly in preserving the underlying households' healthiness and, thus, protect them from diseases and infections. Second, higher level of incomes assists households maintain reasonable levels of homes' sanitation which in turn help in lowering morbidity rates. The coefficient of morbidity rate is positive and significant as expected indicating that a household with members suffer from diseases has a high probability to expose to the risk of catastrophic health expenditures. The coefficients of educational measures are also not significant across different thresholds of catastrophic health expenditure, confirming the outcomes brought by the full sample models.

The impact of household's size on catastrophic expenditure is found to be significant only at 20% level of catastrophic health spending. The most suitable explanation for this outcome is that as household's size goes up, the capacity to spend more on health diminishes and, thus, the portion of these expenditures from total income will not exceed the 20% threshold. In other words, households with larger size are expected to spend more to provide food for their members leaving smaller portions of income to health items. On the other hand, the small size of members, qualifies households to obtain healthiness's inputs such as high-quality food, sanitation, nutrition supplements and prevention and, therefore, maintaining better health. Furthermore, in a developing country context like Sudan, children may involve in economic activities and, hence, contribute in raising their household's average incomes. This is expected to minimize the portion of income devoted to health facilities.

The coefficient of number of members aging more than 65 is positive and significant in all threshold models. This implies that a household with elder members tends to expose to the risk of catastrophic health expenditure. This finding also indicates that elder members are vulnerable to chronic diseases, thus experiencing high risk of catastrophic health expenditure. The coefficient of urban is negative and significant in all models, suggesting that a household residing in urban area is less likely to suffer from the risk of catastrophic health expenditure compared to those who live in rural areas. This can be explained by the fact that most of urban households enjoy high income and better food intake compared to their rural counterparts. Consequently, health expenses undertaken by urban inhabitants will not reach the levels of catastrophes faced by rural residents. In addition, households live in urban areas have high opportunity to enjoy efficient healthcare services like specialized hospitals and medical consultants. Getting access to such facilities would decrease morbidity rates among this category of population and, as a result, their health expenditures will be minimized.

The coefficients of number of rooms are negative and significant, implying that a household with high standard of living has a low probability to expose to catastrophic health expenditure. Interestingly, the coefficient of second income quintile is negative and statistically significant in all catastrophic levels, but the coefficients of the highest income quintiles are insignificant. This result indicates that poor households are more likely to incur the risk of catastrophic health expenditure, while households belonging to top income quintiles have better opportunity to escape the catastrophic health expenditure.

After having introduced the estimation results on the factors that causes the catastrophic health expenditure among Sudanese household, the study goes forward to see whether the influence of these factors differ across urban and rural households**.** The results of equation (10) which address this matter are presented in Table 13 below.

The table shows that there are urban-rural disparities in terms of the determining factors of catastrophic health spending across the three threshold levels (i.e. 10%, 20% and 40%). Similar to the analysis of the pooled sample, the coefficients of household income in the urban sample are negative and significant in all thresholds levels. Nevertheless, in the rural models, although these coefficients are negative, but they fail to preserve the significance even at conventional levels. This result ascertains that households living in urban areas have high income rendering

them to escape the risk of catastrophic expenditure. On the other hand, due to the higher incidence of poverty, in the rural areas the little income does not plays significant role in mitigating the risk of catastrophic health expenditure incurred by rural residents. Resembling the pooled sample outcomes, the influence of morbidity rate in catastrophizing health spending is found to be positive and significant in both the urban and rural samples. Again, this outcome ratifies the strong association between morbidity rates and the occurrence of catastrophic health spending.

In the urban sample, the effect of gender is found to be positive and significant, indicating a positive association between catastrophic health expenditure and household being headed by male. But in the rural models the gender impact is insignificant. This outcome can be understood based on the fact that in rural areas, due to the existence of solid social tightness between different families and clans, gender has no room to affect spending on health matters. In other words, even if household is headed by female with negligible resource that not adequate to fund spending on health, relatives will intervene and share the bills with this household.

Similar to the full sample analysis, the education coefficients are found to be insignificant in all threshold levels in both urban and the rural models. Quite different from the pooled sample, the impact of household size is negative and significant in only 10% and 20% threshold levels of the urban sample, while in the rural sample are not significant. Like the full sample results, the coefficients of number of household members with an age more than 65 year are positive and significant in rural sample threshold models, while are not significant in urban models. This result suggests that a rural household with more elder members has a high probability to face the riskiness of catastrophic health expenditure compared to households living in urban areas. In addition to the justifications given on the pooled sample results, this finding can be further explained by the fact that the size of household in the rural areas is very large, which implying more numbers of elder people. According to 2009's HHS, the percentages of elders were, respectively, 22% and 21% for both rural and urban population (HHS, 2009). Another explanation could be that Sudan has witnessed great domestic immigration especially from rural areas to urban centers. Most of those immigrants were young searching for promising jobs in urban areas. In due course, the immigrant families left the elders in rural areas looking after animals and farms. This has led, and still leads, to increasing the number of elders in rural areas compared to urban centers.

Agreeing with the outcome of pooled sample investigation, in the rural sample, the effect of rooms' number is found to be negative and significant in all threshold levels. However, these coefficients are found to be insignificant when the urban sample is considered. As anticipated, the impact of distance is found to be only significant in the threshold level of 10% in both the urban and rural samples. This indicates that, keeping all else constant, distance alone pushes households to undertake 10% catastrophic health spending. The positive but insignificance of distance variable in 20% and 40% thresholds also indicates the weakness in health infrastructural in the country. In other words, health facilities are mostly equal in poorness. Thus, people tend to travel to the nearest health facilitators making the costs of transportation in health bill smaller.

Finally, like the case of the full sample, households situated in second income quintile are likely to incur less health catastrophic health spending compared to those in first quintile. This is confirmed by the coefficient in front of the variable of the second income quintile which is negative and statistically significant. On the whole, this result implies ~~a~~ strong relationship between the level of income and the likelihood to incur catastrophic health expenditure by Sudanese households.

6.2.3. Expenditure on health care according to household's economic status

Regarding the determinants of household health expenditure by income quintile, Table 14 below reports the results of OLS estimation of equation (8) for five income quintiles.

As can be read from the table, excluding the middle-income quintiles, the coefficient of household income is positive and significant in the first and fifth income quintiles. This result suggests that household's income has important effect on the health spending of households that situated in the lowest and highest income quintiles compared to those of middle quintiles. The interpretation of this conclusion is straightforward. The majority of the households in middle quintiles "middle class" are employed either with government or private sectors both of which make health insurance compulsory. Accordingly, a considerable part of health expenses are shouldered by health insurers. Additionally, the significant health spending by first and fifth income quintiles can be reasoned by the high morbidity rates among poor households (first quintile) and high propensity to seek outstanding healthiness by those who are rich (fifth quintile).

In the same vein, the results also indicate that the effect of morbidity rate is positive and significant in all income quintiles, confirming the results obtained by the analysis of the full, urban and rural samples.

Similar to the aforementioned results, the effect of age of the head of household is found to be negative and statistically significant in all income quintiles. The coefficient of education is found to be positive and significant only for the highest income quintile. This indicates that a household headed by educated person in the high-income quintile spend more on health services compared to those living in the lowest quintiles. Moreover, the effect of household size is only significant in the first quintile, indicating that increasing the number of household member increases health expenditure when the household is categorized among the lowest income quintile. This can be explained by the fact that households with low income are more vulnerable to health spending, particularly those who characterized by larger size. Furthermore, the effect of household with members aging more than 65 is significant in the lowest income quintile, suggesting that low income households suffer from poverty, hence increasing the number of elders rise their health expenditure to catastrophic levels. Moreover, the coefficient related to the number of household members aging less than 5 years is positive and significant only in the top income quintile. This can be interpreted by the fact that household with high standards of living are expected to seek high quality of health services for their children compared to the poor and middle-income classes.

Unexpectedly, the effect of number of rooms is insignificant in all income quintiles models, contradicting the previous analyses. This indicates that, regardless of the position of households in the ladder of incomes and wealth, external environment has a great say in deciding the healthiness and, thus, health expenditures incurred by households. In other words, factors such as sanitation, sewerage, water supply and clean air are curial health input in households' healthiness function. Also, as reported in the table, the coefficients of urban is negative and significant only in the first income quintiles, suggesting that households of low income level living in urban centers tend to spend less than those living in the rural areas. In contrast, the coefficients of regions are found to be insignificant across all income quintiles. This denotes that, regardless of the level of incomes, being living in the states other than Khartoum has no significant effect on the patterns of health spending compared to Khartoum. Living with couple is found to be positive and significant in the first and third income quintiles, suggesting that a household living with family in low and middle-income quintiles tend to spend more on health services than a household in high income quintiles. Finally, apart from the second quintile, the coefficients of distance to health centers turn out to be insignificant in the rest of quintiles. This result indicates that most of the low incomes' households tend to live in the rural and remote

areas which located far from urban centers and, as a consequence, they spend more on health services compared to high income quintiles. This finding also supports the results conveyed by rural sample models.

6.2.4 The impact of CHE on education, food and other expenditures

To understand the effect of OOP health expenditure on household' welfare, we investigate the relationship between CHE and household's expenditure on other life sustaining items such as education and food. Table 15 displays the estimation results of equation (11) for households' budget devoted to education, food and other items, at different thresholds of CHE.

As projected, the findings show that incurring catastrophic health expenditure reduces household's expenditures on education, food and other items. For instance, the coefficients of catastrophic health spending are negative and significant at 1% significance level in all threshold values. This result implies that undertaking catastrophic health expenditure by household crowds out expenditures on education placing negative consequences on educational outcomes and literacy rate. Likewise, in all threshold levels, the effect of catastrophic health spending on food purchases as a share of total income is found to be negative and significant. This finding suggests that expenditure on health services reduces the share of budget allocated to food, hence impoverishes huge number of the households. Moreover, excluding health service, education, and food items, the table indicates a negative association between catastrophic health spending and the budget share allotted to reminder items. This finding is in line with the previous studies which have strongly confirm the impoverishment effects of health spending (e.g. Wagstaff and van Doorslaer, 2006 and van Doorslaer et al., 2006). Overall, these results reveal that the exposure to the risk of catastrophic health expenditure causes an economic shock to households, pushing them either below or closer to poverty line.

6.3. Impoverishment Effects of OOP Health Expenditure

In this subsection, the study presents the empirical results pertaining to poverty effect of OOP healthcare expenditures. In doing so, first we set the poverty line, which used as a benchmark to understand the effect that health expenditure could have on poverty incidence in the country. As proposed in methodology section, this study uses the poverty line of 114 SDG per person per month as assigned by the Central Bureau of Statistics in Sudan in 2009, to measure the poverty incidence among population. This poverty line is estimated based on the cost of obtaining 2470 calories per day per person. Therefore, we measure the household's poverty line as a per capita expenditure equivalent to 114 SDG per month. Narrowing down, to measure the poverty impact of health services' out-of-pocket payments, we calculate the difference in poverty measures pre and post to incur these payments.

6.3.1. The effect of OOP on poverty

As presented in Table 16, the results of poverty impact of health expenditures as proposed in equation (17) through (19) are presented via the three measures of poverty: the poverty headcount, the poverty gap and poverty severity indices.

As can be read from the table, the measures of poverty indicate that the health expenditure has a considerable impact on poverty in the total, urban and rural samples of the households studied. Specifically, estimations indicate that before undertaking health spending, about 41.6% of the total households in Sudan was categorized below the poverty line. However, after considering payments allocated to healthcare, the poverty rate increased to 45.7%, with additional 4.1% of households fell below the poverty line, at the rate of about 10%. Interestingly, this poverty rate is close to the head count ratio of 2009, which was about 46.5%. Compatibly, the poverty gap for the whole sample also has increased from 6 to 7% percent after introducing payments on health. Likewise, the poverty severity index has increased significantly from 2.4% to 2.9% after allowing for the reduction in calories caused by health

expenditures. Generally speaking, these findings predict that health expenditures inflate the incidence of poverty and impoverishment among Sudanese households. Furthermore, owing to OOP expenditures, the poverty impact becomes greater when the illness' complications such as absenteeism from work, losing jobs and low productivity are considered.

Concerning the results on urban sample, Table 16 shows that the occurrence of health expenditures increases poor households by the rate of 17.4%, replicating the results of the whole sample. In addition, a comparison between pre and post-health payments poverty gap demonstrates that health expenditure raises poverty gap by 16.7% among households residing in urban areas. In the same way, the payment on health items extends poverty severity among households by about 21%.

As for the rural sample, the results indicate that poverty rate in rural areas is 49.7%, which is higher than the national and urban rates, confirming the NBHS (2009)' statistics. The results also reveal that health expenditure impoverishes about 4.3% of households in rural areas, by a percentage change of 8.7. This indicates that out-of-pocket health expenditures increases poverty gap from 17.5% to 19.7% in rural areas. Finally, the impact of health expenditure on poverty severity index is very clear, as health spending increases the severity index from 8.4% to 9.6%, with a percentage change of about 14.3%.

On the whole, the results reported above reveal that OOP health expenditures increase the number of poor households at national, urban and rural levels. These findings lend a great support to numerous previous studies (e.g. Xu et al., 2003; van Doorslaer et al., 2006; Wagstaff and van Doorslaer, 2006) which argue that OOP expenditures in general and the catastrophic one in particular disrupt living standards, by either pushing households into poverty or deepening the levels of their current poverty.

6.3.2. The effect of OOP on poverty by income quintiles

For robustness check, we take further step by examining the impoverishment effect of OOP health expenditure for different income quintiles. The result of poor head counts ratios before and after undertaking the payment of health expenses are presented in Figure 5.

As indicated by Figure 5, health payments increase the number of poor households by 3.6% and 5.4% in the first and second quintile, respectively. The third quintile has the highest proportion of households being pushed into poverty due to presence of health expenditures, indicating that the incidence of impoverishment at the poorest quintiles are very low compared to middle quintile. This result may be explained by the fact that households in the lowest income quintile are already live below poverty line, while households positioning in middle quintile are suffers significantly from healthcare payments.

The number of households impoverished by health expenses at the richest quintile is very few; about 1.8% implying that health expenditure pushes only 1.8% of richest households into poverty. This finding can be vindicated based on the ground that most of households who categorized in fifth quintile are rich, thus, health spending does not affect their standard of living significantly. The high proportion of impoverishment in the middle quintile suggests that middle class households represent the most vulnerable category to health expenditure-led poverty. This may occur because most of the people in this category are government officials, relatively well-educated and have high propensity to spend on health matters.

7. Conclusion and Policy Implications

This study examines the determinants of OOP health expenditures and the factors that associated with the risk of catastrophic health expenditure in Sudan. It also investigates the effect of OOP health expenditures on poverty incidence in the country. The study used the NBHS data, 2009, for national, urban and rural levels. To strengthen the insight of the findings obtained, the analysis of OOP expenditures is also executed for different income groups.

The results of the determinants of OOP health expenditures reveal that households' income, incidence of disease, educational level, household size, number of household's members over 65 years and below 5 years old, and distance to healthcare centers have a positive and significant impact on health expenditure when the whole sample of surveyed households is considered. On the other hand, the coefficients of age of household head and the residence in urban areas are found to be negative and significant indicating the contribution of these factors in combating the occurrence of OOP health spending. In addition, the results show some variations between the effects of variables that are supposed to influence health expenditure across urban and rural areas.

Correspondingly, the empirical results of probit model point out a positive and significant association between the risk of incurring catastrophic health expenditure on one side and the incidence of diseases, number of elderly members and children, distance to healthcare centers and household being categorized in the lowest income quintiles on the other. The results of probit analysis also show that the coefficients of income, household size, residing in urban areas and the number of rooms are found to be positive and significant in influencing the likelihood of incurring catastrophic health expenditure at all catastrophic levels. Moreover, the results on urban and rural samples ratify most of the full sample findings, with some disparities in the coefficients pertaining to the analysis executed at rural and urban levels. This urban-rural variation in terms of the factors affecting catastrophic health expenditure needs variety policy interventions to address the problem of inequality in health services provision among urban and rural areas.

Moreover, the paper analyzed the impact of catastrophic health expenditures on household's budget devoted to education, food and other items excluding health expenses. Remarkably, the results reveal that a household with catastrophic health expenditure tends to reduce the budget's share allocated to education, food and other items, respectively. This finding implies that the risk of catastrophic health expenditures results in significant economic shock to households lending a great support to the findings by previous studies.

Finally, the paper examined the impoverishment impact of healthcare expenditures using head count, poverty gap and poverty severity indices. The results indicate that after accounting for health expenditures, the number of poor households increased by about 10%, 17.4% and 8.7% for national, urban and rural samples, respectively. The percentage change in poverty gap and poverty severity indices implies that OOP health expenditures impoverish Sudanese households significantly. The results also tell that households positioning in the middle income quintile is more vulnerable to poverty caused by OOP health expenditures.

Based on the findings discussed above, many policy implications can be drawn to help policymakers in designing appropriate healthcare system strategy. This can help protecting households against the risk of catastrophic health expenditures and to reduce the impoverishment effect of OOP health expenditure when become catastrophic. First, and foremost, reform financing of health system should be at the top agenda of any development strategy in Sudan. Second, to reduce the financial burden resulting from the occurrence of chronic and endemic diseases, a special attention should be paid to the preventive medicine. Taking such policy action can help greatly in mitigating the risk that household suffer from chronic as well as endemic diseases. Third, to reduce the consequences of OOP health expenditures, health services with lower prices should be provided for chronic diseases, especially for poor population. Fourth, health insurance scheme should be expanded in order to accommodate the vulnerable categories of the population. Finally, to reduce the OOP health expenditures, a set of policy actions need to be initiated with the aim to achieve an equitable distribution for health facilities and provision across different communities and regions.

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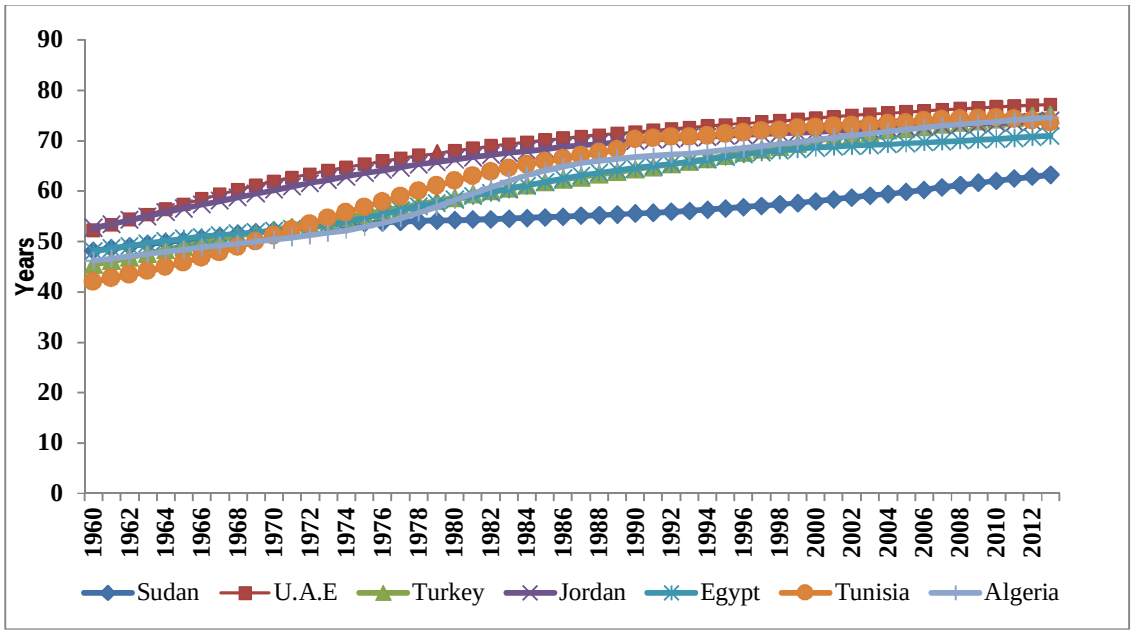
Figure 1: Life Expectancy at Birth In Sudan and A Sample of MENA Countries (1960-2013)



Source: World Bank, World Bank Indicators.

Figure 2: Under Five Years Mortality Rate (per 1,000) in Sudan and a Sample of MENA Countries (1960-2014)

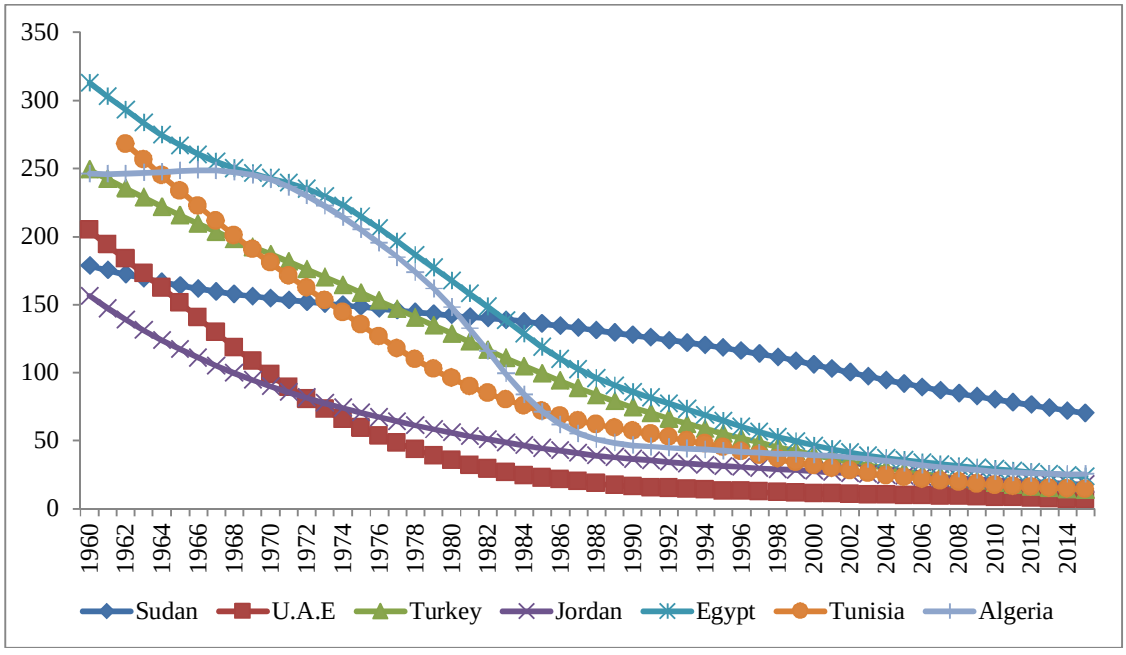
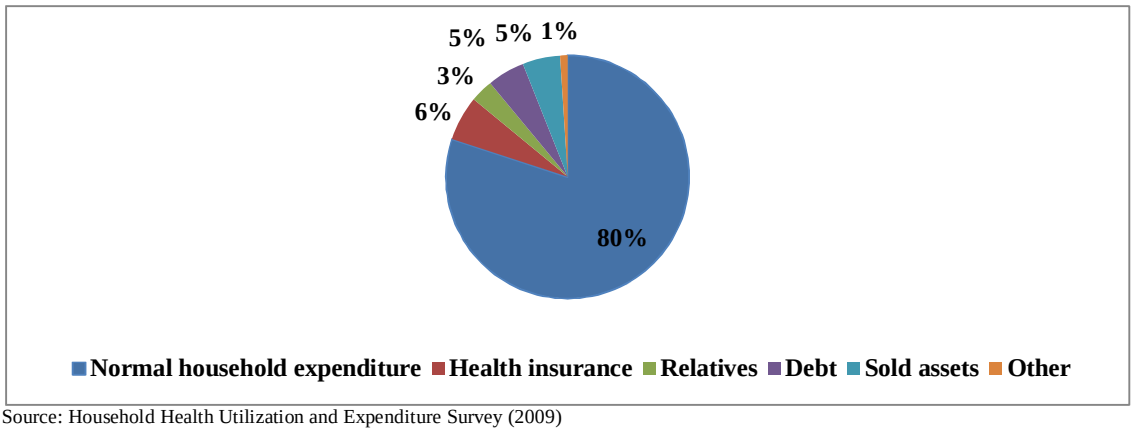
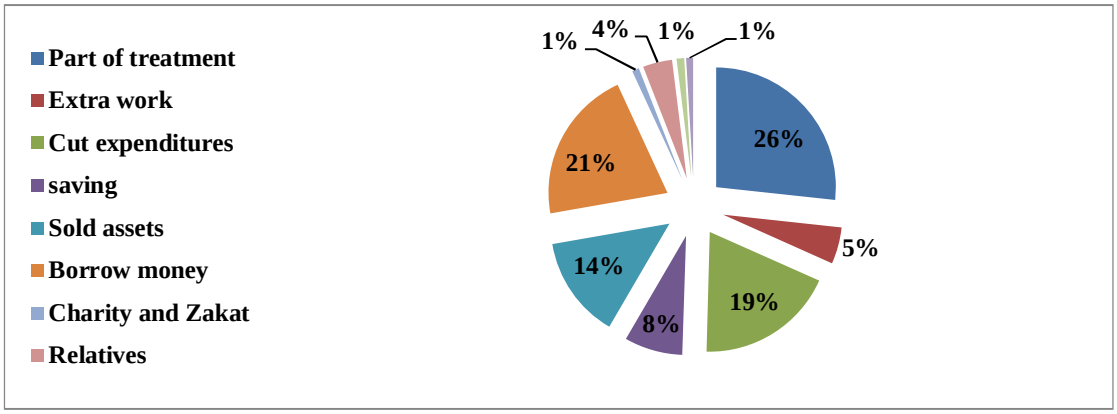


Figure 3: Houshold's sources of fund for health expenditures in Sudan



Source: Household Health Utilization and Expenditure Survey (2009)

Figure 4: Household's Coping Mechanism with Healthcare Expenditures



Source: Household Health Utilization and Expenditure Survey (2009)

Figure 5: OOP Impoverishment effect by Income Quintiles

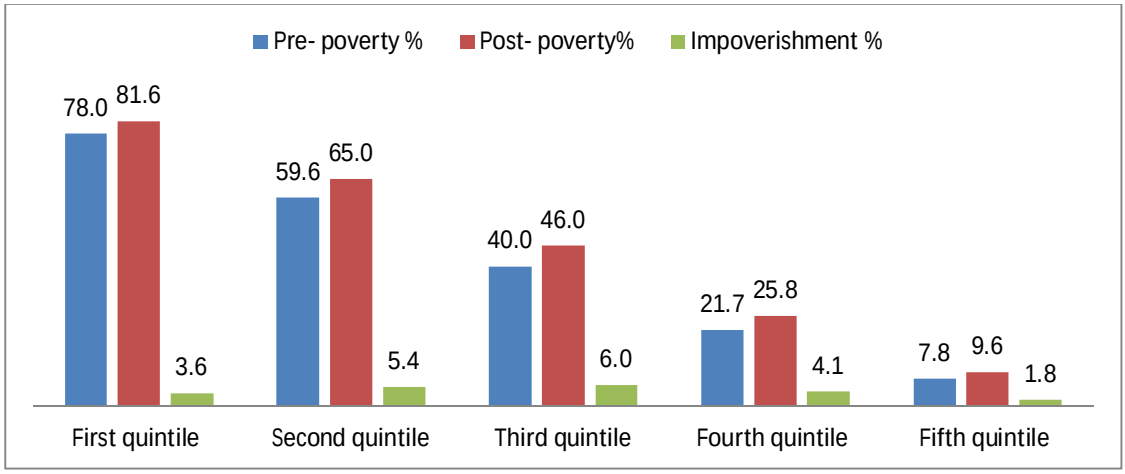


Table 1: The Infant Mortality Rate (1000 live births) in Sudan and a Sample of MENA Countries

Year	Sudan	U. A.E	Turkey	Jordan	Egypt	Tunisia	Algeria
1962-1967	100.6	107.48	146.47	85.37	181.72	159.72	148.8
1968-1973	94.45	68.55	124.48	64.50	160.47	119.68	143.9
1974-1979	90.22	40.45	103.27	50.27	134.77	86.23	121.0
1980-1985	86.33	23.63	80.77	39.48	99.27	61.07	79.47
1986-1991	81.37	15.55	60.33	31.57	68.43	46.95	43.30
1992-1997	75.20	11.53	44.40	26.53	50.8	36.77	36.60
1998-2003	66.98	9.47	31.27	22.97	36.317	25.77	33.33
2004-2009	57.87	8.17	21.07	19.60	27.68	18.10	27.08
2010-2015	50.48	6.57	13.83	16.57	22.23	13.47	22.45

Source: World Bank, World Bank Indicator (2014).

Table 2: Life Expectancy at Birth, total (years) in Sudan and a Sample of MENA Countries

	Life expectancies at birth (years)				GDP per capita (constant 2005 US$)			
Year	Sudan	MENA	SSA	World	Sudan	MENA	SSA	World
1960-1964	49.0	47.8	41.0	53.6	494.8	-	734.9	3279.2
1965-1969	51.1	50.7	43.1	57.4	455.2	1272.1	814.9	3895.9
1970-1974	52.9	53.6	45.1	60.3	429.1	1760.2	933.4	4475.1
1975-1979	53.9	56.7	47.1	62.1	517.4	2031.4	965.4	4861.7
1980-1984	54.4	59.0	48.8	63.5	473.9	1771.8	933.2	5114.1
1985-1989	55.0	62.8	49.8	64.8	443.0	1683.1	861.2	5541.3
1990-1994	55.9	66.5	49.9	65.8	463.7	1714.9	800.1	5876.2
1995-1999	57.1	68.5	49.9	66.9	518.1	1832.4	785.7	6274.0
2000-2004	58.7	69.8	51.1	68.3	599.7	2055.1	814.1	6822.1
2005-2009	60.7	70.9	54.2	69.6	749.3	2415.0	930.7	7469.7
2010-2013	62.6	72.0	57.2	70.9	900.1	2556.5	996.4	7767.9

Source: World Bank, World Bank Indicator (2014).

Table 3: Acute Disease Specific Episodes Distribution by Residence and Economic Status (%)

Disease	Malaria	Respiratory	Diarrheal	Minor Injury	Ophthalmic	Abscess	Viral HB	Typhoid fever
Residence								
Urban	3.9	4.6	0.8	0.2	0.8	0.1	0.1	0.4
Rural	4.7	3.4	0.9	0.2	0.8	0.1	0.1	0.2
Total	4.4	3.8	0.9	0.2	0.8	0.1	0.1	0.3
Economic status								
Quintile1	3.6	3.2	1.2	0.2	0.7	0.0	0.1	0.1
Quintile2	4.1	3.2	0.8	0.2	0.6	0.1	0.1	0.1
Quintile3	4.9	3.9	0.8	0.2	0.6	0.1	0.1	0.3
Quintile4	5.2	3.9	0.8	0.2	0.8	0.2	0.2	0.3
Quintile5	4.6	4.8	0.8	0.2	1.2	0.2	0.1	0.6

Notes: Adopted from Sudan Household Health Utilization and Expenditure Survey (2009).

Table 4: Chronic Disease Specific Episodes Distribution by Residence and Economic Status (%)

Disease	Hypertension	Diabetic	Asthma	Cardiac	UTI	Cancer	Psychiatric	Malnutrition
Residence								
Urban	3.0	2.0	0.7	0.4	0.2	0.1	0.2	0.0
Rural	1.1	0.6	0.4	0.2	0.3	0.2	0.2	0.1
Total	1.7	1.1	0.5	0.3	0.2	0.2	0.2	0.0
Economic status								
Quintile1	0.3	0.2	0.3	0.1	0.2	0.1	0.2	0.1
Quintile2	0.8	0.4	0.4	0.1	0.2	0.2	0.2	0.1
Quintile3	1.4	0.7	0.5	0.2	0.2	0.1	0.1	0.0
Quintile4	1.8	1.3	0.6	0.2	0.2	0.2	0.2	0.0
Quintile5	4.3	3.0	1.0	0.6	0.4	0.2	0.2	0.0

Notes: Adopted from Sudan Household Health Utilization and Expenditure Survey (2009).

Table 5: Public Health Expenditure (% of GDP and Government Expenditure) in Sudan and a Sample of MENA Countries

Public health expenditure (% of GDP)							
Year	Sudan	U. A. E	Turkey	Jordan	Egypt	Tunisia	Algeria
1995-1998	0.88	2.0	2.67	5.29	1.88	2.87	2.56
1999-2002	0.90	1.81	3.33	4.81	2.29	2.87	2.69
2003-2006	1.37	1.47	3.83	4.60	2.11	2.89	2.49
2007-2010	2.22	2.0	4.47	5.76	2.0	3.33	3.18
2011-2013	1.64	2.16	4.22	5.37	1.99	4.17	4.32
1995-2013	1.40	1.89	3.70	5.17	2.05	3.23	3.05
Public health expenditure (% of government expenditure)							
Year	Sudan	U. A. E	Turkey	Jordan	Egypt	Tunisia	Algeria
1995-1998	12.23	7.99	10.75	14.75	6.29	8.09	8.36
1999-2002	8.25	8.03	9.35	14.30	7.24	8.26	8.42
2003-2006	6.51	8.78	10.95	12.29	6.04	9.18	8.25
2007-2010	10.14	9.42	11.59	16.98	5.75	11.34	8.41
2011-2013	11.31	9.39	10.91	16.19	5.89	13.33	9.39
Public health expenditure (% of total health expenditure)							
Year	Sudan	U. A. E	Turkey	Jordan	Egypt	Tunisia	Algeria
1995-1998	22.81	78.74	70.75	59.49	41.68	52.68	72.08
1999-2002	25.39	73.87	65.70	49.84	40.39	53.64	74.16
2003-2006	32.16	60.18	69.84	52.39	39.83	52.13	72.58
2007-2010	32.37	65.15	75.11	64.88	41.08	55.06	70.68
2011-2013	24.97	69.69	77.92	66.46	40.13	59.22	72.69

Source: World Bank, World Bank Indicators

Table 6: Private Health Expenditures (% of GDP) in Sudan and a Sample of MENA Countries

	Private health expenditure (% of GDP)						
Year	Sudan	U. A. E	Turkey	Jordan	Egypt,	Tunisia	Algeria
1995-1998	2.96	0.54	1.10	3.62	2.66	2.58	0.99
1999-2002	2.67	0.65	1.73	4.84	3.38	2.48	0.93
2003-2006	2.88	0.97	1.66	4.19	3.19	2.66	0.94
2007-2010	4.64	1.04	1.48	3.09	2.87	2.70	1.33
2011-2013	4.94	0.94	1.19	2.72	2.96	2.87	1.61

Source: World Bank, World Bank Indicators.

Table 7: Out-of-Pocket Health Expenditure (% Of Private Expenditure on Health) in Sudan and a Sample of MENA Countries

Year	Sudan	U. A. E	Turkey	Jordan	Egypt	Tunisia	Algeria
1995-1998	92.86	69.88	99.79	67.20	93.44	83.85	96.84
1999-2002	91.58	71.05	72.15	74.98	97.65	80.97	96.36
2003-2006	92.06	73.94	68.21	85.08	98.37	83.34	95.21
2007-2010	95.46	68.90	70.59	81.37	97.79	85.53	96.58
2011-2013	95.94	63.19	69.38	71.74	97.72	86.67	97.23

Source: World Bank, World Bank Indicators.

Table 8: The Distribution of Catastrophic Expenditures by Residence and Economic Status

Residence	Catastrophic spending (10%)	Catastrophic spending (20%)	Catastrophic spending (40%)
Urban	44.16	20.54	9.28
Rural	52.57	28.88	5.16
Total	49.96	26.29	8.00
Economic status			
Quintile1	45.42	26.78	9.35
Quintile2	51.61	26.91	7.90
Quintile3	50.70	26.55	9.36
Quintile4	51.36	25.08	6.44
Quintile5	50.70	26.11	6.95

Source: Sudanese Households' Survey (2009).

Table 9: The Distribution of Households' Catastrophic Expenditures by Region and Economic Status in Sudan

Educational status	Catastrophic spending (10%)	Catastrophic spending (20%)	Catastrophic spending (40%)
Primary	49.61	25.13	6.78
Secondary	47.90	23.30	5.99
Post-secondary	37.50	20.83	6.25
University	48.66	21.79	4.48
Region			
Northern State	53.22	27.84	8.81
Eastern State	43.50	21.84	6.12
Khartoum State	51.99	25.24	6.83
Central State	54.86	30.79	9.33
Kordfan State	50.00	24.76	7.78
Darfur State	47.00	25.05	8.10

Source: Sudanese Households' Survey (2009).

Table 10: Descriptive Statistics of the Variables Used in the Analysis

Variable	Definition	Mean	Std. Dev	Min	Max
Income	Total household income in SDG	852.464	31606.61	0	2808140
Health expenditure	Health expenditure in SDG	58.701	139.98	0	5245.167
Food expenditure	Food expenditure in SDG	544.601	374.208	5.16	8585.208
Non- food expenditure	Non- food expenditure in SDG	339.332	359.945	7.966	11653.25
Gender	Gender of the head of household (1 = male; 0 = female)	0.895	0.305	0	1
Age	Age of head of household in years	45.811	14.80	15	95
Primary	Primary school, dummy	0.192	0.393	0	1
Secondary	Secondary school, dummy	0.078	0.268	0	1
Post-secondary	Post-secondary, dummy	0.006	0.077	0	1
University	University, dummy	0.042	0.201	0	1
Wage employed	Dummy variable (1= wage employment, 0= otherwise)	0.410	0.491	0	1
Household size	Number of household 'members	6.172	2.806	1	28
No. > 65 years	Number of household's members more than 65 years	0.253	0.521	0	5
No. < 5 years	Number of household's members less than 5 years	0.930	1.019	0	8
Number of Rooms	Number of Rooms	3.264	1.869	1	19
Urban	Dummy variable (1= urban, 0= otherwise)	0.3107545	0.462	0	1
Central	Dummy variable (1= central, 0= otherwise)	0.266	0.442	0	1
Northern	Dummy variable (1= northern, 0= otherwise)	0.133	0.340	0	1
Eastern	Dummy variable (1= eastern, 0= otherwise	0.200	0.400	0	1
Kordufan	Dummy variable (1= Kordufan, 0= otherwise	0.133	0.339	0	1
Darfur	Dummy variable (1= Darfur, 0= otherwise	0.199	0.399	0	1
Married	Dummy, (1= married; 0= unmarried)	0.895	0.305	0	1
Divorced	Dummy, (1= divorced; 0= unmarried)	0.018	0.133	0	1
Widowed	Dummy, (1= widowed; 0= unmarried)	0.052	0.223	0	1
Distance	Distance in minutes	21.37647	34.283	1	360

Table 11: Estimation of Household's Health Expenditure: Full sample, Urban and Rural

Dependent variable: log of health expenditure (% of total expenditure)			
Variable	**Total**	**Urban**	**Rural**
Log (Income)	0.043***	0.030	0.045***
	0.000	0.122	0.000
Morbidity	0.588***	0.615***	0.581***
	0.000	0.000	0.000
Gender	0.044	0.039	0.052
	0.172	0.572	0.155
Age	-0.001**	0.0001	-0.001***
	0.029	0.775	0.014
Primary	0.059***	0.072*	0.058
	0.006	0.073	0.022
Secondary	0.086**	0.090	0.093**
	0.015	0.113	0.042
Post-secondary	0.128	0.237	0.131
	0.277	0.239	0.364
University	0.217***	0.256***	0.162**
	0.000	0.001	0.044
Wage employed	-0.001	-0.061*	0.011
	0.928	0.059	0.532
Household size	0.014***	-0.004	0.018***
	0.000	0.557	0.000
No. > 65 years	0.068***	0.022	0.073***
	0.000	0.565	0.000
No. < 5 years	0.005	0.019	0.001
	0.487	0.277	0.848
Number of Rooms	0.009*	0.022*	0.005
	0.096	0.058	0.377
Urban	-0.028		
	0.149		
Central	-0.034	-0.112	0.000
	0.451	0.078	0.997
Northern	-0.091*	-0.065	-0.067
	0.093	0.543	0.400
Eastern	-0.023	-0.076	0.008
	0.606	0.208	0.913
Kordufan	-0.058	-0.118*	-0.022
	0.208	0.064	0.764
Darfur	-0.074	-0.003	-0.065
	0.101	0.957	0.380
Married	0.065	-0.013	0.085
	0.219	0.892	0.187
Divorced	0.040	0.087	0.015
	0.611	0.565	0.867
Widowed	0.044	0.013	0.041
	0.519	0.917	0.622
Distance	0.027***	0.028	0.029**
	0.000	0.121	0.001
Constant	0.474***	0.610***	0.411***
	0.000	0.001	0.000
Observations	6875	2135	4740
Adj R-squared	21.5	19.6	22.2

Note: ***p<0.001,**p<0.01,*p<0.05.

Table 12: Probit Estimation for Catastrophic Health Expenditure for the Full Sample

Variable	Coefficients		
	10%	20%	40%
Log (Income)	-0.0220***	-0.0107*	-0.0070**
	0.008	0.090	0.035
Morbidity	0.5548***	0.3207***	0.1041***
	0.000	0.000	0.000
Gender	0.0224	0.0383	0.0132
	0.484	0.105	0.292
Age	-0.0003	-0.0001	0.0002
	0.625	0.820	0.388
Primary	-0.0117	0.0015	-0.0015
	0.600	0.930	0.865
Secondary	0.0278	-0.0178	-0.0234
	0.452	0.527	0.111
Post-secondary	-0.1321	0.0615	0.0181
	0.265	0.530	0.734
University	-0.0168	-0.0506	-0.0130
	0.774	0.262	0.599
Wage employed	-0.0196	-0.0011	0.0068
	0.231	0.927	0.310
Household size	-0.0055	-0.0046*	-0.0023
	0.122	0.091	0.113
No. > 65 years	0.0452**	0.0315**	0.0122*
	0.012	0.018	0.071
No. < 5 years	0.0278***	0.0094	0.0019
	0.002	0.155	0.597
Urban	-0.1265***	-0.0880***	-0.0282***
	0.000	0.000	0.000
Number of Rooms	-0.0211***	-0.0179***	-0.0064***
	0.000	0.000	0.008
Married	0.0062	0.0416	0.0229
	0.906	0.296	0.284
Divorced	0.0165	0.0692	-0.0274
	0.836	0.302	0.401
Widowed	-0.0074	0.0489	0.0342
	0.913	0.387	0.343
Distance	0.0230***	0.0115*	0.0039
	0.003	0.05	0.210
Second quintile	0.0024	-0.0426**	-0.0183**
	0.914	0.012	0.033
Third quintile	0.0126	-0.0195	-0.0048
	0.522	0.279	0.610
Fourth quintile	0.0318	-0.0384**	-0.0160
	0.220	0.044	0.101
Fifth quintile	0.0510*	-0.0344	-0.0080
	0.079	0.109	0.480
Observations	5189	5189	5189
Pseudo R^2	0.2172	0.1404	0.0968

Note: ***p<0.001,**p<0.01,*p<0.05.

Table 13: Probit Estimation for Catastrophic Health Expenditure for Urban and Rural Sample

Variable	Urban			Rural		
	10%	20%	40%	10%	20%	40%
Log (Income)	-0.0542***	-0.0371***	-0.0102***	-0.0144	-0.0042	-0.0040
	0.005	0.002	0.001	0.114	0.566	0.319
Morbidity	0.5090***	0.2246***	0.0387***	0.5613***	0.3455***	0.1165***
	0.000	0.000	0.000	0.000	0.000	0.000
Gender	0.0948	0.0879**	0.0160**	0.0035	0.0183	0.0053
	0.140	0.013	0.039	0.924	0.521	0.740
Age	0.0015	0.0003	0.0004*	-0.0007	-0.0002	0.0001
	0.309	0.754	0.099	0.345	0.754	0.838
Primary	-0.0238	0.0376	0.0071	-0.0032	-0.0117	-0.0053
	0.54	0.137	0.300	0.904	0.576	0.648
Secondary	-0.0321	-0.0370	-0.0036	0.0964*	0.0202	-0.0255
	0.554	0.286	0.698	0.046	0.596	0.203
Post-secondary	0.1298	0.2189	-	-0.2399	0.0168	0.0541
	0.520	0.171	-	0.100	0.891	0.467
University	0.0852	0.0547	0.0162	-0.1199	-0.1202*	-0.0367
	0.295	0.333	0.360	0.154	0.055	0.294
Wage employed	-0.0132	-0.0251	0.0066	-0.0232	0.0064	0.0034
	0.670	0.195	0.183	0.217	0.672	0.681
Household size	-0.0159**	-0.0089**	-0.0016	-0.0022	-0.0026	-0.0016
	0.023	0.044	0.163	0.594	0.429	0.386
No. > 65 years	0.0018	-0.0016	-0.0032	0.0532***	0.0373**	0.0167**
	0.962	0.948	0.612	0.009	0.017	0.042
No. < 5 years	0.0232	0.0153	0.0054**	0.0273	0.0068	-0.0014
	0.183	0.152	0.041	0.006	0.386	0.754
Number of Rooms	-0.0061	-0.0083	-0.0015	-0.0244***	-0.0203***	-0.0078***
	0.598	0.264	0.441	0.000	0.000	0.010
Married	-0.128	0.0340	0.0538***	0.0560	0.0373	0.0180
	0.171	0.562	0.000	0.369	0.450	0.506
Divorced	0.0493	0.3287**	0.9895***	0.0279	0.0086	-0.0508
	0.743	0.025	0.000	0.764	0.911	0.143
Widowed	-0.1081	0.1939*	0.9938***	0.0291	0.0004	0.0016
	0.333	0.079	0.000	0.716	0.995	0.967
Distance	0.0281*	0.0151	0.0028	0.0217**	0.0110	0.0035
	0.098	0.157	0.299	0.012	0.109	0.356
Second quintile	0.0001	0.0109	0.0164	-0.0101	-0.0549***	-0.0270***
	0.998	0.782	0.229	0.681	0.004	0.008
Third quintile	-0.0483	0.0363	0.0188	-0.0148.	-0.0339	-0.0097
	0.419	0.358	0.162	0.581	0.102	0.380
Fourth quintile	-0.0282	-0.0015	0.0121	-0.0434	-0.0470**	-0.0226*
	0.640	0.967	0.334	0.137	0.036	0.054
Fifth quintile	-0.1220	0.0006	0.0211	-0.0178	-0.0362	-0.0167
	0.052	0.988	0.156	0.594	0.160	0.220
Observations	1142	1142	1136	4047	4047	4047
Pseudo R^2	0.2259	0.1555	0.1634	0.2124	0.1335	0.0882

Note: ***p<0.001,**p<0.01,*p<0.05.

Table 14: Estimation of Household Health Expenditure by Income Quintile

Dependent variable : log of health expenditure (% of total expenditure)					
Variable	**1st quintile**	**2nd quintile**	**3rd quintile**	**4th quintile**	**5th quintile**
Log (Income)	0.030**	0.006	-0.024	0.017	0.035*
	0.035	0.711	0.186	0.357	0.090
Morbidity	0.941***	0.953***	1.042***	0.941***	1.104***
	0.000	0.000	0.000	0.000	0.000
Gender	0.011	0.073	0.066	0.037	-0.115
	0.836	0.246	0.383	0.635	0.191
Age	-0.001	-0.001	-0.001	-0.0005	-0.001
	0.316	0.246	0.279	0.735	0.538
Primary	0.079	0.044	0.014	0.030	0.097*
	0.131	0.335	0.749	0.484	0.078
Secondary	0.158	-0.102	0.051	0.093	0.133*
	0.106	0.238	0.497	0.187	0.071
Post-secondary	-	0.434	-0.047	-0.227	0.180
	-	0.400	0.876	0.374	0.300
University	-0.013	-0.282	-0.070	0.229**	0.264***
	0.964	0.280	0.613	0.034	0.002
Wage employed	0.045	0.0003	-0.005	0.037	-0.043
	0.175	0.992	0.869	0.285	0.322
Household size	0.015**	0.009	0.009	0.006	0.0009
	0.044	0.195	0.201	0.417	0.906
No. > 65 years	0.081**	0.055	0.022	0.103***	0.018
	0.025	0.142	0.585	0.006	0.656
No. < 5 years	0.012	0.016	0.006	0.031	0.048
	0.509	0.346	0.748	0.102	0.016
Rooms	0.003	-0.006	0.003	-0.007	0.014
	0.789	0.569	0.766	0.502	0.259
Urban	-0.091*	-0.082*	-0.122***	-0.118***	-0.127***
	0.077	0.056	0.002	0.003	0.008
Central	0.026	-0.055	-0.018	0.025	0.004
	0.852	0.568	0.853	0.764	0.969
Northern	0.045	-0.110	-0.017	-0.144	-0.097
	0.779	0.334	0.879	0.189	0.464
Eastern	0.005	-0.085	-0.127	-0.058	-0.086
	0.968	0.375	0.203	0.502	0.415
Kordufan	0.193	0.043	-0.075	-0.034	0.010
	0.174	0.662	0.467	0.708	0.922
Darfur	0.060	-0.100	-0.026	0.054	-0.050
	0.665	0.303	0.795	0.546	0.619
Married	0.182	0.025	0.191	0.062	0.167
	0.069	0.825	0.054	0.569	0.173
Divorced	0.137	0.156	0.365**	0.052	0.082
	0.298	0.367	0.035	0.772	0.734
Widowed	0.153	-0.081	0.093	0.006	0.140
	0.202	0.584	0.502	0.964	0.403
Distance	0.020	0.026	0.012	0.024	0.007
	0.173	0.085	0.467	0.167	0.739
Constant	-0.192	0.345*	0.444**	0.377*	0.238
	0.334	0.071	0.018	0.066	0.294
Observations	1323	1206	1056	905	699
R squared	0.4673	0.4440	0.4689	0.4096	0.4239

Note: ***p<0.001,**p<0.01,*p<0.05.

Table 15: Impact of Health Expenditure on Education, Food, and other Expenditures

Threshold	10%	20%	40%
Education Expenditure as share of total Expenditure			
Catastrophic coff	-0.006*** (0.000)	-0.006*** (0.000)	-0.009*** (0.000)
F test	65.29 (0.000)	58.61(0.000)	45.92(0.000)
Food Expenditure as share of total Expenditure			
Catastrophic coff	-0.054*** (0.000)	-0.003*** (0.000)	-0.112*** (0.000)
F test	121.26 (0.000)	247.00(0.000)	413.67(0.000)
Expenditure on Remaining Items as share of total Expenditure			
Catastrophic coff	-.0543*** (0.002)	-0.1582*** (0.000)	-0.2632 *** (0.000)
F test	9.98 (0.001)	66.05(0.000)	69.44 (0.000)

Note: ***p<0.001,**p<0.01,*p<0.05.

Table 16: Impoverishment Impact of Healthcare Expenditure

Total Sample			
	Incidence	**Poverty Gap**	**Poverty Severity**
Pre- health expenditure %	41.6	14	6.5
Post- health expenditure %	45.7	15.8	7.5
Impoverishment %	**4.1**	**1.8**	**1**
Percentage change	**9.9**	**12.9**	**15.4**
Urban Sample			
	Incidence	**Poverty Gap**	**Poverty Severity**
Pre- health expenditure %	23	6	2.4
Post- health expenditure %	27	7	2.9
Impoverishment %	**4**	**1**	**0.5**
Percentage change	**17.4**	**16.7**	**20.8**
Rural Sample			
	Incidence	**Poverty Gap**	**Poverty Severity**
Pre- health expenditure %	49.7	17.5	8.4
Post- health expenditure %	54	19.7	9.6
Impoverishment %	**4.3**	**2.2**	**1.2**
Percentage change	**8.7**	**12.6**	**14.3**