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Out of Pocket Healthcare Expenditures: Determinants and Impacts on the Livelihoods of Urban Households in Selected Sudanese States

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Abstract

This study investigates determinants of out-of-pocket and catastrophic healthcare expenditures (OOPHE and CHE) incurred by urban households in five Sudanese states, namely, Red Sea, Kassala, Gadarif, Sinnar, and South Darfur. The study also examines the impact of CHE on the livelihoods of households in these states. To achieve these aims, the study applies ordinary least squares (OLS) and probit regression methods to data sourced from Sudanese National Baseline Household Surveys (NBHSs) conducted in 2009 and 2014. An analysis based on the 2009 NBHS shows that OOPHE is significantly influenced by factors such as household size, the head of household's educational level, and the presence of elderly household members. When the 2009 data is disaggregated to the state level, however, the analysis demonstrates that household income, enrollment in a health insurance program, very young (under age 5) household members, the head of household's educational level, the head of household's gender, and the family's wealth correspond the most significantly to the amount of OOPHE a family incurs. Interestingly, the analysis based on the 2014 NBHS indicates that health insurance, the family's wealth, and the head of household's age, gender, wage employment, and marital status are correlated with OOPHE. The analysis based on disaggregated data from 2014 indicates that OOPHE is significantly correlated with factors such as the head of household's age, household size, the head of household's educational level, wealth, and distance from healthcare facilities. Furthermore, the analysis shows that CHE is significantly correlated with health insurance enrollment, family wealth, household size, distance from healthcare facilities, and the head of household's age and education. Finally, the investigation reveals that a high level of CHE is accompanied with lower shares of food and non-food purchases in a household's total expenditures and, thus, worsens households' livelihoods in those other domains. Based on these findings, the study ends with some recommendations aimed at alleviating the burden of private healthcare spending on urban households in the states under consideration.

1. Introduction

In 1992, the Sudanese government implemented a package of economic policies entitled the "Structural Adjustment Program" (SAP), along with economic reforms recommended by the International Monetary Fund. In compliance with SAP and IMF recommended policies, the Sudanese government has reduced its interventions in economic activities, and initiatives have awarded the production of some public goods (such as healthcare services and education) to the private sector. Advocates of the SAP have argued that, compared to the public sector, privately owned business entities are more efficient in managing scarce resources. For example, in the area of health, in 1992 the government introduced a user-fees system to finance healthcare services as a substitute for the tax-based system inherited from British colonizers. The user-fees system permitted private providers to supply healthcare services at market prices to financially capable segments of the population. However, it soon became clear for both policymakers and health authorities that the user-fees system failed to provide adequate healthcare services to the vast majority of people, particularly the poor (Abdu et al. 2004; Lagarde and Palmer 2008).

To mitigate the catastrophic drawbacks of the user-fees system, in 1995 the government launched the country's first public health insurance scheme. The declared goals of the scheme were to promote the utilization of healthcare services, to make healthcare services available to all individuals, and to reduce the incidence of OOPHE incurred by Sudanese households (Ebaidallah and Ali 2019). However, current statistics demonstrate that these goals are still out of reach. Healthcare spending in the form of OOPHE has remained very high, suggesting that the public health insurance scheme has failed to protect people against health-related financial hardship. The World Development Indicators show that OOPHE represented 65% of total healthcare spending in Sudan during the 1998–2018 timeframe (World Bank 2020).

The incidence of OOPHE is likely higher in some states, especially in states with poor records in terms of disease, prevalence of poverty, and social stability. In particular, the exposure of the population to OOPHE in the states affected by wars and disasters—including the Red Sea, Kassala, Gadarif, Sinnar, and South Darfur—is anticipated to be higher compared to the rest of the country. The 2009 Sudanese National Baseline Household Survey (NBHS) indicates that large portions of population in these five states live under the poverty line[1]. Moreover, these states experience a high incidence of both chronic and acute diseases. For example, the average prevalence of diseases such as malaria, respiratory infections, and malnutrition in these five states exceeds the national average (Sudan Federal Ministry of Health, 2009). What makes the situation even worse is the fact that the

[1] Approximately the percentage of households who live under poverty line is estimated to be 36.3% in Kassala, 57.7% in Gadarif, 50.1% in Red Sea, 44.1% in Sinnar, and 60.1% in South Darfur.

majority of households in these states are not covered by health insurance: only about 20.6% of the population in Kassala, 36.5% in Gadarif, 23.6% in Red Sea, 27.4 in Sinnar, and 15.8% in South Darfur have health insurance (Ali Siddig and Hassan, 2016).

No doubt, all these factors contribute to increases in OOPHE incurred by the population of these five states. However, the burden of OOPHE on urban populations is expected to be even higher. This is so because (at the current stage of development) urban centers in these states receive huge waves of immigration from rural areas, coupled with immigration from neighboring countries. For instance, along with flows of internal immigrants, the eastern states of Gadarif, Kassala, and Red Sea receive huge numbers of foreigners from Ethiopia and Eritrea. In South Darfur state, rates of immigration (mostly from rural to urban centers) have intensified since wars erupted in 2003. Such a growth in urban residents would certainly be expected to increase OOPHE incurred by urban residents.

Furthermore, the high incidence of poverty and disease in these five states coincides with poor infrastructures in rural areas, which puts health services in urban centers under the pressure of extensive usage. In other words, an unbalanced distribution of infrastructure between rural and urban areas pushes rural residents to commute to urban centers to receive healthcare services. Thus, public facilities in urban areas are exhausted by large numbers of rural users pushing urban households to spend a large portion of their incomes on healthcare services.

The exposure of a large proportion of households to OOPHE hardship is likely to generate serious human development consequences in these states. Previous studies have frequently shown that OOPHE represents a heavy burden on a household's budget, particularly for the poor (Bonu, Bhushan, and Peters 2007; Xu et al. 2007; Bredenkamp, Mendola, and Gragnolati 2010; Berman, Ahuja, and Bhandari 2010; Reddy et al. 2011; Shahrawat and Rao2012; Van Minh et al. 2013; Arsenijevic 2013). OOPHE reduces the proportion of income a household is able to allocate to education, food, and other necessities. Several studies have shown that healthcare spending diminishes household expenditures on necessities and, therefore, deepens the poverty of vulnerable groups (Van Doorslaer et al. 2006; Chuma and Maina 2012; Bhojani et al. 2012; Awiti 2014; Ebaidallah and Ali 2019). To give a relevant example, Ebaidallah and Ali (2019) study the impact of OOPHE on the poverty status of Sudanese households in Sudan and find that incurring OOPHE increases the rate of poverty and impoverishment among urban Sudanese households and significantly reduces their expenditures on education, food, and other life-sustaining items.

Based on the above concerns, three questions can be raised regarding OOPHE and its impact on urban households in Red Sea, Kassala, Gadarif, Sinnar, and South Darfur: (1) what are the determining factors of OOPHE incurred by urban households in these states? (2) Which factors are likely to push urban households in these states to incur healthcare expenditures that reach catastrophic levels? And (3) what is the impact of OOPHE on the livelihoods of urban households in these states

(that is, the impact of OOPHE on the shares of food and non-food household expenditures)? To answer these questions, this study applies ordinary least squares (OLS) and probit regression techniques to data sourced from two rounds of the NBHS conducted by Sudan's Central Bureau of Statistics in 2009 and 2014.

2. Importance of the study

This study gains importance in several aspects. First, the size of the urban population in the Sudanese states under investigation has increased significantly during the last four decades. Other than the internal immigration, three of these states (Red Sea, Kassala, and Gadarif) are exposed to great waves of immigrants from neighboring countries. Congestion in urban areas imposes great pressures on healthcare facilities available to urban populations. Therefore, examining the determining factors of OOPHE incurred by urban population in these states is very timely. Specifically, the outcomes of this study could help policymakers develop appropriate actions to bridge the gap between supply and demand of healthcare services and thus put an end to skyrocketing OOPHE.

Second, at the current stage of development, the states under study need a wide range of investments to mitigate chronic poverty. The occurrence of wars and disasters has created an inhospitable business environment, which deters local and foreign investments and, consequently, deepens the incidence of poverty experienced by urban populations. The eastern states of Red Sea, Kassala, and Gadarif, for instance, have been severely affected by wars waged between the government and the rebel movements of the East Front and Alusoud Elhura. South Darfur state has similarly experienced (and still experiences) prolonged wars with its all the accompanying negative consequences, including genocide, displacement, and destruction of assets. Sinnar state has been affected by the chronic instability prevailing in its neighboring states, namely, Blue Nile and Gadarif. All of these complications discourage business investment and as a result increase the incidence of poverty. To make these states hospitable for both foreign and domestic investors, policymakers need to create mechanisms for human capital development. However, this goal cannot be achieved if the labor force remains exposed to high OOPHE with its adverse effects on labor and productivity. Identifying determinants of OOPHE and the impacts of OOPHE on the livelihood of urban populations could raise policymakers' awareness of how OOPHE hinders economic development in these states.

Third, the states under study suffer greatly from the prevalence of diseases that are linked to poverty, poor standards of living, and deficient health infrastructure, including (but not limited to) tuberculosis, anemia, malaria, and chikungunya. The pervasiveness of such diseases increases the pace of OOPHE and traps a large portion of citizens in a vicious circle of poverty. Owing to this situation, this study could be of great importance for those who combat poverty in these states. The study aims to assist such actors to make informed decisions regarding poverty reduction and the inclusion of vulnerable groups in urban areas. In the end, achieving a triumph over poverty may pacify the ethnic tensions and overcome social unrests in Sudan.

Finally, in the last five years, policymakers in Sudan have taken steps towards the goal of achieving universal health insurance coverage by 2020. However, the evidence demonstrates that bringing the entire population under a health insurance umbrella is out of reach in the current situation. With this in mind, this study may contribute towards achieving this goal. Specifically, giving accurate findings on the negative impacts of OOPHE on the livelihoods of urban populations may encourage policymakers to take further steps and actions to accelerate the expansion of health insurance to include all segments of the population.

3. Objectives of the study

This study aims to identify the determinants of healthcare expenditures and their impacts on the livelihoods of urban populations in five Sudanese states, Red Sea, Kassala, Gadarif, Sinnar, and South Darfur. In particular, this study endeavors to:

1. Identify determinants of OOPHE incurred by urban populations in the selected states;
2. Detects whether the determining factors determinants of OOPHE incurred by urban populations vary among the states;
3. Discover whether the determining factors of OOPHE incurred by urban populations vary among male and female-headed households.
4. Identify the factors that are likely push OOPHE to exceed certain limits or thresholds and, thus, become catastrophic.
5. Explore OOPHE impact on the livelihood of urban residents.

4. Literature review

Researchers have devoted a large volume of studies to investigating the determinants and impacts of OOPHE and CHE on people's livelihoods in both developed and developing countries. However, the findings often differ based on the socio-economic contexts in which the issues are investigated. The characteristics of the health system in a certain country or among a certain population group also shape the determinants and impacts of healthcare spending. Looking at the developing country context, for instance, Malik and Syed (2012) study the socio-economic determinants of household OOPHE in Pakistan, applying OLS regression methods to data sourced from Household Integrated Economic Survey (HIES) and Pakistan Standard of Living Measurement (PSLM) Surveys. They conclude that factors such as non-food expenditures, literacy of household head and spouse, using an unhygienic toilet, having had a child within the last three months, drinking unsafe water, and residing in the Khyber Pakhtunkhwa province are the main predictors of a household's OOPHE. In the same regional context, Pal (2010) finds that the educational level of the household head plays a critical role

in deciding the amount of OOPHE incurred by an Indian household. Similarly, Chaudhuri and Roy (2008) find that the ability to pay is a key determining factor of OOPHE in Vietnam.

Instead of directly studying determinants of OOPHE, some scholars have focused on health insurance coverage as a predictor of private healthcare spending (Johnson and Krishnaswamy 2012; Azam 2018). Johnson and Krishnaswamy, for instance, use 2009 data from the Indian National Sample Survey Organization to estimate the impact of the Indian national health insurance scheme (Rashtriya Swasthya Bima Yojana, or RSBY) on hospitalization and OOPHE. They use a difference in difference approach, and their results reveal that the scheme led to a small reduction in OOPHE for outpatient healthcare services. However, Azam (2018) challenges Johnson and Krishnawamy's findings. He uses longitudinal nationally representative household survey data to investigate the impact of RSBY on household's per capita and per patient OOPHE and finds (among other things) that RSBY does not lead to a significant reduction in per capita OOPHE incurred by both rural and urban households.

OOPHE is considered to be a "catastrophic" healthcare expenditure (CHE) when it exceeds a certain threshold of a household's income or capacity to pay. Some researchers have examined the factors that push OOPHE to catastrophic levels. For example, Misra et al. (2015) examine the determinants of CHE in urban Lucknow, India, using data based on a cohort of 400 households. Their analysis indicates that both hospitalization and prolonged sickness without hospitalization are associated with higher CHE. Relying on data sourced from Iranian household income and expenditure survey, Yazdi-Feyzabadi et al. (2018) study the prevalence and intensity of CHE in Iran from 2008 to 2015. The authors define CHE as healthcare expenditures exceeding 40% of a household's income after subtracting living expenses. Their analysis indicates that the average monthly OOPHE was low in rural areas over the years 2008 to 2015; however, the prevalence of CHE was quite high in comparison to urban areas during this time period. The authors conclude that rural settlement, higher income, receiving inpatient and outpatient services, and the existence of elderly household members increases CHE. In the same way, Amaya-Lara (2016) investigates the incidence and determinants of CHE in Colombia using probit regression techniques. His analysis is based on household data sourced from the 2011 Colombian Quality of Life National Survey. He classifies households as having CHE when OOPHE exceeds 20% of the household's capacity to pay and finds that about 9.6% of the Colombian households surveyed had CHE. In addition, the author finds that factors such as having a large number of household members, having children or elderly household members, residing in a rural area, and being uninsured are positively correlated with the incidence of CHE.

Along with studying determinants of healthcare spending, a strand of research has been devoted to exploring the role of OOPHE and CHE in shaping a population's poverty status. Koch, Pedraza, and Schmid (2017), for instance, study the extent to which OOPHE exposes Chilean households to financial catastrophe and impoverishment. The authors conduct a systematic literature review to

explore empirical studies analyzing financial protection in Chile. They find that 4% of Chilean households face CHE, defined as OOPHE exceeding 30% of the household's capacity to pay, but less than 1% of the Chilean population has been pushed into poverty due to CHE. Similarly, using data sourced from Sudan's 2009 National Baseline Household Survey Ebaidalla and Ali (2019) examine determinants of OOPHE for national, urban, and rural households in Sudan. Their results reveal that the incidence of disease, household income, literacy level of the head of, household size, and the number of household members over age 65 or below age 5 are all key factors that drive a household's OOPHE. Furthermore, they find that households that have elderly or very young members or belong to the lowest income quintile are more likely to be pushed into CHE. More importantly, the findings show that a considerable portion of the Sudanese population falls below the poverty line after incurring OOPHE.

Applying both bivariate and multivariate analyses to data obtained from the World Health Organization's Study on Global Ageing and Adult Health, Kumar et al. (2015) assess the socioeconomic- differentials that influence the impact of OOPHE on the incidence of poverty in China and India. Interestingly, they find that OOPHE pushed 7% (in China) and 8% (in India) of the total population into poverty. Moreover, their multivariate analysis indicate that lacking wealth, having inpatient and outpatient healthcare raises households' OOPHE and, as a consequence, increases the likelihood of falling below poverty line in both countries. Likewise, Rahman et al. (2013) examine the determinants of high healthcare expenditures and healthcare related financial catastrophe in Bangladesh using data collected from a cross-sectional household survey conducted in Rajshahi. They find that the poorest households have a four times higher risk of incurring CHE than the rich. Additionally, the authors find that the risk of exposure to financial catastrophe among those who use inpatient and outpatient public and private healthcare facilities is higher than the risk among those who only use traditional healers.

Garg and Karan (2009) use Consumer Expenditure Survey data from the Indian National Sample Survey conducted 1999–2000 to investigate the differential impact of OOPHE on inpatient care, outpatient care, treatments, and poverty across different income quintiles in both developed and less developed regions in India. Their most important finding is that OOPHE increases overall poverty by 1%. In the African context, Onwujekwe, Hanson, and Uzochukwu (2012) use data collected by interviewer administered questionnaires from 4,873 households to assess CHE incurred by the population of four local government areas in southeast Nigeria. The CHE was measured using a threshold of 40% of monthly non-food expenditure. They find that urban populations incur higher OOHPE than other socio-economic groups. However, the incidence of CHE is higher among poorer and rural residents.

In their widely cited study, Van Doorslaer et al. (2006) challenge conventional estimates of poverty, arguing that these estimates turn a blind eye to the effect of OOPHE on a household's poverty status.

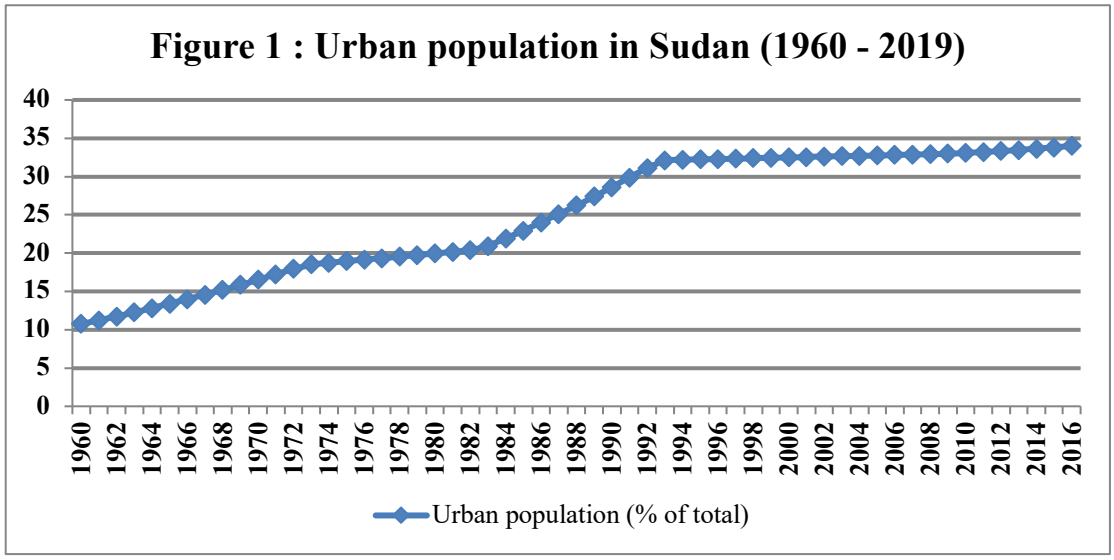
Using data on healthcare expenditures from nationally representative surveys, the authors reassess poverty estimates in 11 low and middle-income countries in Asia after considering OOPHE. Interestingly, they find that, after taking into account OOPHE, the prevalence of absolute poverty in these countries increases14% above the conventional poverty estimates.

Some studies focus on the prevalence of illness as a measure for the backbreaking burden facing those who incur OOPHE. For instance, Thuan et al. (2006) use OOPHE on communicable and non-communicable illnesses as burdens of illness encountered population in the Vietnamese Bavi district. They confirm that communicable diseases represent the main cause of higher levels of OOPHE and that this type of illnesses is more dominant among poor populations.

On the whole, the literature reviewed above confirms that the determinants of OOPHE and CHE are principally linked to socioeconomic, demographic and health characteristics of the households being studied. This conclusion lends support to conducting an independent analysis to investigate the determinants and impacts of OOPHE in the Sudanese states under consideration (Red Sea, Kassala, Gadarif, Sinnar, and South Darfur). In particular, previous studies, including the Sudanese study conducted by Ebaidallh and Ali (2019), leave unanswered questions about the determinants and impacts of OOPHE and CHE at regional levels. In addition, the above reviewed studies do not give attention to the role of gender in deciding the route of healthcare spending. This study fills this gap by considering the effect of the gender of the head of household on OOPHE and CHE undertaken by urban households in the selected Sudanese states. Moreover, as shown in the reviewed literature, researchers often narrow down their analysis by studying determinants and the impact of OOPHE at the lowest administrative levels, such as district, region, or province. This motivates us to study these hot issues in each of these five states separately, since each state is likely to possess its own socioeconomic, demographic, and geographical characteristics.

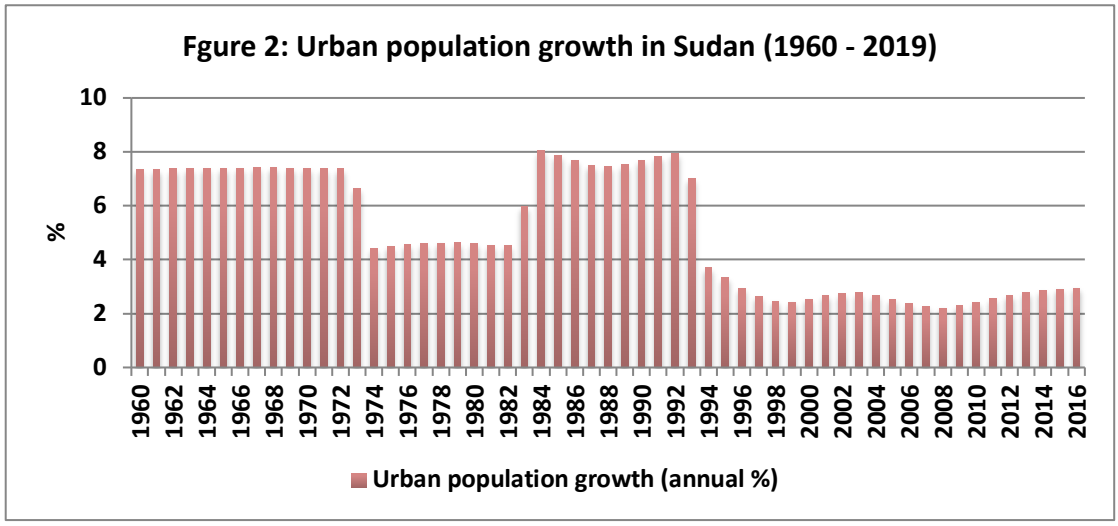
5. Urban populations in Sudan: Some stylized facts

In the last five decades, the urban population in Sudan has grown dramatically. According to the World Bank, this segment of the population grew from representing 10.75% of the total population in 1960 to 33% of the total population in 2019 (World Bank 2020). Figure 1 below depicts the urban proportion of Sudan's total population during the 1960–2019time period. Starting from the 1960s, the urban population began to grow more rapidly, reflecting socioeconomic transformations in the country. These transformations included the occurrence of drought, famine, as well as the eruption of wars in the South Darfur, South Kordofan, and Blue Nile states. These developments pushed urban population to reach one-third of the country's total population at the beginning of the 1990s, and it has stayed at roughly this level since that time.



Source: World Development Indicators (World Bank 2020)

Figure 2 portrays the growth rates of Sudan's urban population during the 1960–2019 period. Growth rates were higher during the 1960s and again in the 1980s, reflecting the country's demographic, political, and social changes. However, the increase in the 1980s was somewhat higher than the increase in the 1960s. This can be partially interpreted by the different factors leading to the two waves of urban population growth. In the 1960s, urban population growth was mainly driven by the expansion in the national economic base and the relative political stability that the country enjoyed in that period. It seems those developments motivated a large portion of the rural population to move to urban areas. Alternatively stated, people began immigrating to urban areas to gain a share of the economic pie which (due to the bias in allocating development projects) was confined to urban centers. In contrast, in the 1980s, rural people were pushed to immigrate to urban areas because of unfavorable economic and climate conditions. During that period, rural areas were exposed to tough waves of drought and famine that pushed the population (particularly, in western Sudan) to move to Khartoum and regional capital cities. In short, urban population growth in the 1960s was driven by pull factors, while urban population growth in the 1980s was caused by push factors. The impact of the push factors on urban population growth was larger than that caused by the pull factors.



Source: World Development Indicators (World Bank 2020)

The urban population grew at more moderate rates during the 1970s, 1990s, and 2000s. A reasonable interpretation for this phenomenon may be that Sudan enjoyed a degree of political stability during these periods. In 1972, for instance, Sudan signed a peace agreement with the Southern Sudan Liberation Movement (SSLM) in Addis Ababa, which ended the first civil war that had been waged in Sudan from 1955 to 1972.Peace brought by the Addis Ababa agreement may have slowed the waves of internally displaced persons to urban areas, given that areas affected by the first civil war were mostly located in the rural southern regions. Likewise, in 2005, the government of Sudan came into agreement with the Sudan People's Liberation Movement (SPLM), ending the second civil war waged in 1983. That agreement brought relative political stability to southern regions, including South Kordofan and Blue Nile states, which lessened push factors for immigration to urban centers. In addition, this political stability led to significant economic progress, which could have motivated the rural population to stay in rural areas, thus lessening pull factors for immigration.

In short, a number of overlapping factors have led the Sudanese urban population to grow dramatically during the last five decades. This evolution in the urban population has generated and continues to generate huge pressures on infrastructure in urban areas. Among these pressures, the congestion of the population in urban centers has created large shortages in healthcare services, pushing people to incur OOPHE. Moreover, the population density in urban areas boosts the spread of disease, particularly endemic disease, which may also intensify the burden of healthcare expenditures encountered by urban population. In the end, increases in OOPHE means people have less money to spend on other life needs, such as education, sanitation, and food, thus deepening the incidence of poverty among urban residents. Ebaidalla and Ali (2019) document that OOPHE push a large portion of Sudan's population (in both urban and rural areas) to fall into poverty. This situation will only improve if policymakers increase efforts to eliminate the impoverishing impacts of skyrocketing OOPHE.

5.1. Urban population growth in Sudan

Although the total urban population in Sudan has grown significantly during the last decades, urbanization has increased faster in some regions. For instance, compared to other regions, the populations of Kassala, Port Sudan, and Gadarif cities have seen huge increases since 1973. Several reasons have collectively driven growth in these cities, but a key reason is that these cities were exposed to huge waves of refugees from Eritrea after the beginning of the war of independence waged between the Eritrean Liberation Front and the Ethiopian government in 1960. That war pushed thousands of Eritreans to flee to eastern Sudan, leading to great increases in the urban population of the mentioned cities. As Table 5.1 shows, between 1973 and 1983, the populations of Kassala, Port Sudan, and Gadarif cities grew by 4.2%, 5.5%, and 7.6%, respectively.

Table 5.1. Population trends in select Sudanese cities, 1973–2008

	Population from census				Intercensal average growth rate		
City	1973	1983	1993	2008	1973–1983	1983–1993	1993–2008
Gedarif	66,465	116,876	191,164	269,395	5.6%	4.9%	3.4%
Kassala	99,652	141,429	234,622	298,529	3.5%	5.1%	2.4%
Khartoum	333,906	473,597	947,483	1,410,858	3.5%	6.9%	4.0%
Khartoum North	150,989	340,857	700,887	1,012,211	8.1%	7.2%	3.7%
Nyala	59,583	111,693	227,183	492,984	6.3%	7.1%	7.7%
Omdurman	299,399	526,192	1,271,403	1,849,659	5.6%	8.8%	3.7%
Port Sudan	132,632	206,038	308,195	394,561	4.4%	4.0%	2.5%
Sinjah	19,452	27,982	--	56,058	3.6%	--	--
Sinnar	28,546	42,803	72,187	123,158	4.1%	5.2%	5.3%

Source: 2008 priority census tables, Central Bureau of Statistics, Sudan

As Table 5.1 shows, the growth rate of urban population remained quite high until the beginning of the 1990s. In Kassala, Port Sudan, and Gadarif cities, the population growth rate dropped dramatically in the 1993–2008 time period, signifying the end of the Eritrean war of independence. In other words, after the end of war in neighboring countries, increases in urban populations may be attributed to regular waves of immigrants from rural to urban centers.

Other cities saw even more sizeable population increases. For instance, the population of Nyala (South Darfur's capital) has grown considerably, mirroring the end of the second civil war in 2005. In fact, the average growth rates in Nyala exceeded those in Khartoum, Sinnar, Kassala, Gadarif, and Port Sudan cities. Perhaps these higher growth rates reflect the role of war in displacing a large number of people from their rural incubators to the state's urban center where they could find security and humanitarian support.

On the whole, as Table 5.1 shows, urban populations grew at alarming rates between 1973 and 2008. Urban population growth goes hand in hand with a need for policymakers to upgrade infrastructure to meet increased urban demand.

5.2. Access to healthcare in Sudan

High growth rates in Sudan have not always corresponded to expansions in infrastructure, especially in the areas of health and education. As Table 5.2 shows, a great gap exists between the available healthcare facilities and the medical needs of urban populations in the states of Red Sea, Gadarif, Kassala, Khartoum, Sinnar, and South Darfur. Furthermore, there are significant disparities in the distribution of healthcare facilities and personnel across these states. For instance, the number of medical technicians per 100,000 individuals in Khartoum state is approximately 18 times that in Red Sea, 6 times that in Gadarif, 9 times that in Kassala, and 7 times that in Sinnar and South Darfur states. Overall, the number of medical staff in Khartoum state exceeds that in other states by 62%. The image is a bit better corrected when it comes to medical assistants. However, it is well known this category of medical practitioners not qualified to engage in vital medical interventions in cases of severe diseases. Nonetheless, Sinnar state outperforms Khartoum state in terms of the number of medical assistants per 100,000 residents.

Table 5.2. Medical staff per 1000,00 residents in selected states, 2016

	Medical staff (total)				Medical staff (per 100,000 residents)			
State	Technicians	Medical assistants	Nurses	Public health officers	Technicians	Medical assistants	Nurses	Public health officers
Gadarif	833	111	800	110	41.4	5.5	44.7	5.5
Kassala	578	192	857	34	24.5	8.1	36.3	1.4
Khartoum	5,076	228	4,343	165	68.7	3.1	58.8	2.2
Red Sea	284	102	557	43	19.6	7.1	38.5	3.0
Sinnar	698	292	1077	46	39.3	16.4	60.6	2.1
South Darfur	726	254	544	40	18.3	6.4	13.7	1.0
Sudan (overall)	**14,291**	**2,999**	**16,037**	**1,135**	**26.1**	**7.6**	**40.5**	**2.9**

Source: Annual Health Statistical Report (Sudan Federal Ministry of Health 2016)

The above statistics reflect bitter realities of the Sudanese health system. First, there are great variations in the distribution of medical staff between the presidential state (Khartoum) and the rest of the country. Second, at the national level, the number of medical staff in the country is insufficient for the population. Third, healthcare facilities are currently concentrated in urban areas. This reality is likely to push large portion of rural populations (particularly those with underlying medical conditions) to immigrate to urban centers, generating more pressure on already inadequate healthcare facilities. In the long run, this is likely to lead to the under-provision of healthcare services, increases in OOPHE, and amplified poverty impacts.

Table 5.3. Hospitals and beds per 100,000 residents in selected states, 2016

State	Total population	Number of hospitals	Number of beds	Hospitals per 100,000 residents	Beds per 100,000 residents
Gedarif	2,012,614	33	1,668	1.6	82.9
Kassala	2,360,083	22	1,334	0.9	56.5
Khartoum	7,385,158	49	6,734	0.7	91.2
Red Sea	1,445,353	28	1,356	1.9	93.8
Sinnar	1,777,982	34	1,781	1.9	96.6
South Darfur	3,968,978	21	1,207	0.5	30.4
Sudan (overall)	**39,598,700**	**503**	**30,308**	**1.3**	**76.5**

Source: Annual Health Statistical Report (Sudan Federal Ministry of Health 2016)

Table 5.3 gives statistics on hospitals and beds per 100,000 residents in the Red Sea, Gadarif, Kassala, Sinnar, South Darfur, and Khartoum states. Both the number of beds and hospitals available per100,000 residents are far from the international standards recommended by the WHO. For instance, Kassala, Khartoum, and South Darfur states have no more than one hospital per 100,000 residents, although Red Sea, Gadarif, and Sinnar seem to be better than the national average. Of course, the number of residents a hospital can serve in reality depends on the number of beds in the hospital. Importantly, the number of hospital beds per 100,000 residents is below the national average in Kassala and South Darfur states.

Further revelations about disparities between the states under comparison appear when considering the number of doctors and specialists per 100,000 residents. As revealed in Table 5.4, there are great gaps between the number of specialists and the size of population in each of the states under comparison. Not surprisingly, Khartoum state captures the lion's share of specialists and doctors. South Darfur state has the lowest number of specialists and doctors. This is the case, even though the capital city of South Darfur (Nyala) is Sudan's second largest city in terms of population. The great differences between states may indicate that certain segments of Sudan's population are face severe shortages in healthcare access. The problem is even more shocking if we take into consideration the negative consequences of war on health.

Table 5.4. Specialists and doctors per 100,000 residents in selected states, 2016

	Total			Per 100,000 population		
State	Doctors	Dentist	Specialists	Doctors	Dentists	Specialists
Gadarif	186	5	65	9.2	0.2	3.2
Red Sea	144	14	63	10.0	1.0	4.4
Kassala	245	10	81	10.4	0.4	3.4
Khartoum	2,102	220	772	28.5	3.0	10.5
Sinnar	250	12	66	14.1	0.7	3.7
South Darfur	72	5	29	1.8	0.1	0.7
Sudan (overall)	**9,175**	**838**	**1,813**	**23.2**	**1.1**	**4.6**

Source: Annual Health Statistical Report (Sudan Federal Ministry of Health 2016)

5.3. Healthcare expenditures by households

Households in Kassala, Gadarif, Sinnar, South Darfur, and Red Sea states have seen an increase in their healthcare expenditures over the last decades. As Table 5.5 shows, the mean of total healthcare expenditures in these states increased between 2009 and 2014. In fact, the average healthcare spending by household in Sinnar and South Darfur states in 2014 was approximately four times that in 2009. In Kassala and Gadarif states, average healthcare spending per household increased six fold, and in Red Sea state average healthcare spending increased eleven fold. These large jumps in average healthcare spending per household are mirrored by significant differences in the maximum amounts spent by households in 2009 and 2014.

Table 5.5.Average household healthcare expenditures (in SDG) in selected states, 2009 and 2014

State		Observations	Mean	Std. Dev.	Minimum	Maximum
Gadarif	2009	528	60.06267	133.2655	0.00	1602.5
Kassala		528	65.30979	139.5607	0.00	2283.667
Red sea		528	19.89583	48.34498	0.00	406.5
Sinnar		527	102.9442	341.1373	0.00	5245.167
South Darfur		527	56.77587	109.0155	0.00	1534.667
Gadarif	2014	497	383.4045	564.2551	0.00	7267.803
Kassala		501	387.0145	553.6492	0.00	4653.456
Red sea		689	209.4394	707.8038	0.00	11723.95
Sinnar		535	390.8156	439.4038	0.00	5191.51
South Darfur		608	251.8745	347.0284	0.00	3,745.259

Source: Annual Health Statistical Report (Sudan Federal Ministry of Health 2016)

In summary, households' average healthcare expenditure in these five states grew significantly between 2009 and 2014. Combined with the high urban population growth in these states, due to immigration from rural to urban areas and war, the high OOPHE suggests a great negative livelihood impact on households in these states.

6. Research methods

6.1. Models Specification

Based on the above reviewed literature and following the steps of Grossman (1972), Parker and Wong (1997), and Su, Kouyaté, and Flessa (2006), the model for determinants of OOPHE incurred by urban households in the Red Sea, Kassala, Gadarif, Sinnar and South Darfur states can be written as follows:

$$lnOOPHE_i = \alpha_0 + \alpha_1 HI_i + \alpha_2 lnInc_i + \alpha_3 Age_i + \alpha_4 Gend_i + \alpha_5 lnHsize_i + \alpha_6 Pedu_i + \alpha_7 Sedu_i + \alpha_8 Psedu_i + \alpha_8 Unedu_i + \alpha_9 Child_i + \alpha_{10} Old_i + \alpha_{11} Wealth_i + \alpha_{12} Wemp_i + \alpha_{13} Mar_i + \alpha_{14} Divo_i + \alpha_{15} Wido_i + \alpha_{16} dist_i + \mu_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where $ln\ OOPHE$ is the natural logarithm of healthcare expenditures undertaken by an urban household during the month preceding the survey. This variable captures the demand by urban households for healthcare services and acts as a substitute for healthcare seeking behavior of the population in the studied states. HI_i stands for a household's health insurance status and takes a value of 1 if the household is insured (and 0 otherwise). $lnInc_i$is the natural logarithm of a household's monthly income.$Age_i$is the age of the head of household.$Gend_i$ indicates the gender of the head of household and takes a value of 1 if male and 0 if female.$lnHsize_i$indicates the number of individuals in the household. $Pedu_i$ takes a value of 1 if the head of household attended primary school (and 0 otherwise).$Sedu_i$ takes value of 1 if the head of household attended secondary education (and 0 otherwise).$Psedu_i$takes a value of 1 if the head of household attended post-secondary education (and 0 otherwise).$Unedu_i$takes value of 1 if the head of household attended university(and 0 otherwise). $Child_i$indicates the number of household members who are younger than 5.Old_iI ndicates the number of household members who are older than 65 members. $Wemp_i$takes value of 1 if the head of household has wage employment (and 0 otherwise).$Wealth_i$ indicates the head of household's wealth, which is measured by the number of rooms in the household's place of residence.Mar_itakes a value of 1 if the head of household is married (and 0 otherwise).$Divo_i$ takes a value of 1 if the head of household is divorced (and 0 otherwise).$Wido_i$takes a value of 1 if the head of household is widowed(and 0 otherwise).$dist_i$indicates the time it takes to travel to the nearest healthcare facilities (measured in minutes), and μ_i is an error term that is assumed to be normally distributed.

According to previous literature, enrollment in a health insurance program lowers OOPHE paid by households. Therefore, the coefficient of health insurance (HI_i)is expected to carry a negative sign. In contrast, the coefficient of household income ($lnInc_i$) should be positive, increases in income permit a household to seek more and higher quality(i.e., more expensive) healthcare services. The coefficient of gender ($Gend_i$)is expected to be positive, since male-headed households are likely to generate higher incomes than female-headed households and, thus, incur higher levels of OOPHE.

The coefficient of head of household age (Age_i) is expected to be positive, since older heads of household are more likely than younger heads to suffer from chronic diseases and thus to spend more on healthcare. Similarly, the coefficients of young ($Child_i$) and older (Old_i) household members should be positive, since members of these age groups tend to be exposed to higher morbidity rates. The coefficient of household size ($lnHsize_i$) is expected to be positive, since larger households have higher morbidity rates and greater OOPHE.

The educational achievement of the head of household should have a positive impact on OOPHE. Literate heads of household are more likely to be capable of accessing high quality healthcare facilities, as well as to understand the value in doing so. Thus, the coefficients of all of the variables relating to educational level ($Pedu_i$, $Sedu_i$, $Psedu_i$, and $Unedu_i$) should be positive.

The effect of wage employment (*Wemp*$_i$) is expected to be negative. If the head of household is employed, the household is more likely to have health insurance coverage and, accordingly, will spend less on healthcare than a household with an informally or self-employed head of household that does not have membership in a health insurance plan. The wealth variable (*Wealth*$_i$) should have a positive coefficient, since households are wealthier are likely to spend more on healthcare. The coefficient of marital status (*Mar*$_i$) should be positive, since married heads are likely to spend more on healthcare. However, the coefficients of the divorce (*Divo*$_i$) and widowed (*Wido*$_i$) variables cannot be determined prior to empirical investigation. Finally, the effect of distance (*dist*$_i$) is expected to be positive, as a household residing far away from hospitals and health centers pay more on transportation to reach these centers.

The second model is designed to examine determinants of CHE incurred by urban households. Adopting the method introduced by Berki (1986), Wyszewianski(1986), and O'Donnell et al.(2005), CHE is defined according to three threshold levels, namely, 10%, 20%, and 30% of a household's total expenses on non-food items. This study follows the lead of Wagstaff and Van Doorslaer (2003) by using household's non-food expenses as an indicator for household's capacity to pay. Hence, CHE is set equal to the proportion of OOPHE to non-food expenditures, as follows:

$$CHE = \frac{OOPHE}{nonfex} \dots\dots (2)$$

Here, *CHE* is the share of OOPHE in non-food expenditure, *OOPHE* is a household's average monthly expenditures on health, and *nonfex* is a household's average monthly expenses on non-food expenses. This model's relationship to the determinants of CHE can be expressed as follows:

$$CHE_i = \alpha_0 + \alpha_1 HI_i + \alpha_2 lnInc_i + \alpha_3 Age_i + \alpha_4 Gend_i + \alpha_5 lnHsize_i + \alpha_6 Pedu_i + \alpha_7 Sedu_i + \alpha_8 Psedu_i + \alpha_8 Unedu_i + \alpha_9 Child_i + \alpha_{10} Old_i + \alpha_{11} Wealth_i + \alpha_{12} Wemp_i + \alpha_{13} Mar_i + \alpha_{14} Divo_i + \alpha_{15} Wido_i + \alpha_{16} dist_i + \varepsilon_i \dots\dots (3)$$

CHE$_i$ represents the dependent variable, which takes the value of 1if the household experiences CHE (that is, its OOPHE exceeds the threshold levels) and zero otherwise, whileε_i is an error term that is assumed to be normally distributed. The other explanatory variables affecting CHE are identical to those appearing in equation (1).

This study examines the effect of healthcare spending on the livelihoods of urban households. In this regard, one concern is the impact of CHE on food and non-food expenditures. The model to detect this impact is shown as follows:

$$foodexp_i = \alpha + \varphi CHE_i +_i \beta S_i + \lambda D_i + \mu_i (4)$$

Here, $foodexp_i$ represents the average monthly food expenditures undertaken by an urban household in the sample under consideration, CHE_i is household catastrophic healthcare expenditures, and S_i and D_i respectively represent socioeconomic and demographic characteristics of each household.

The model to capture the impact of CHE on average monthly non-food expenditures is formulated by replacing an urban household's average monthly food expenditures on the left-hand side of equation (4) with non-food expenditures, as follows:

$$nonfoodexp_i = \alpha + \varphi CHE +_i \beta S_i + \lambda D_i + \mu_i (5)$$

Where $nonfoodexp_i$s represents the average monthly non-food expenditures undertaken by an urban household in the sample under consideration. The explanatory variables affecting urban household's non-food expenditures are identical to those appearing in equation (4).

6.2. Data

The data for this study is sourced from two rounds of the Sudanese Baseline Households Survey (NBHS), conducted by the Central Bureau of Statistics in 2009 and 2014. The NBHS represents the largest survey in Sudan and represents national level as well as rural and urban strata. It contains data on all individual, demographic, social, economic, and location characteristics of the households surveyed. Specifically, the dataset contains information on households' expenditures on food, non-food items, healthcare, and other utilities. In total, the 2009 NBHS includes data from 2,638 households, while the 2014 NBHS includes data from 2,830 households in the five states that are part of this study. Of these total households, this study focuses on urban households, that is, 948 households in 2009 and 913 households in 2014, as shown in Table 5.6 below.

State	Urban households in 2009	Urban households in 2014
Gadarif	133	144
Kassala	156	156
Red Sea	384	384
Sinnar	120	120
South Darfur	144	144

Source: Sudanese Baseline Household Surveys (Sudan Central Bureau of Statistics 2009; 2014)

The survey collected data on each household's OOPHE during the 30 days prior to being surveyed, including spending on the services of medical doctors, medical tests, pharmaceutical products, birth delivery, and hospital services. The data on healthcare expenditures does not include in-kind

payments, informal payments to health workers, or loss of income due to injury or illness. Tables 1 and 2 in the appendix display descriptive statistics on the variables under consideration.

6.3. Estimation methodology

estimate the above models, namely, ordinary least squares (OLS) and probit. The OLS regression technique is used to estimate models on the determinants of OOPHE. For comparability purposes, equation (1) is estimated based on total data and also is estimated based on data disaggregated by whether the household is in an urban or rural area, the state where the household is located, and the gender of the head of household. The study uses the probit regression technique to estimate the model pertaining to determinants of CHE, as represented by equation (3). We adopt this technique because the dependent variable is a binary variable that takes a value of 1 if urban households report CHE and 0 otherwise. Furthermore, equation (3) is estimated using three thresholds of CHE spending: 10%, 20%, and 30%. Finally, equations (4) and (5), which convey the impoverishment impact of CHE, are estimated using OLS methods.

7. Empirical results

This section starts by introducing the results on the determinants of OOPHE and CHE undertaken by total, urban, and rural households in the five Sudanese states under study. Accordingly, it reports and compares the study's findings regarding determinants of OOPHE and CHE based on the 2009 and 2014 NBHSs. This section then presents the results on the impact of OOPHE on households' livelihoods.

7.1. Determinants of OOPHE using 2009's NBHS

Table 7.1 reports our findings on determinants of OOPHE incurred by urban households in the selected states, using the 2009 NBHS. To allow for a comparative analysis, the table shows the data disaggregated between the urban and rural household samples, as well as the aggregated total data pool. Many of the variables' coefficients are of acceptable magnitudes and associated with the expected signs; however, several variables lack significance even at conventional levels.

For instance, the coefficient associated with the health insurance variable is negative in the urban context, but lacks statistical significance. Nonetheless, it is statistically significant when the urban and rural data is aggregated, which suggests that having health insurance reduces OOPHE and confirms a relatively large number of previous studies that find that expanding health insurance membership reduces OOPHE paid by insured households (Sepehri, Simpson, and Sarma 2006; Cavagnero et al. 2006; Johnson and Krishnaswamy 2012; Kusi et al. 2015; Habib, Perveen, and Khuwaja 2016; Okoroh et al. 2018). However, other studies have found evidence that health insurance participation boosts OOPHE incurred by the insured (Newhouse 1992; Ekman 2007;Selvaraj and Karan 2012). According to these studies, health insurance membership increases the level of medical visits and,

accordingly, diagnosis by those who are insured. In other words, individuals who are insured are more likely to discover they have a medical condition and will consequently pay more on medication and consultancies that are not covered by the insurance.

Looking at household income, the coefficient in the rural setting is significant, but the coefficient in the urban setting is not. This outcome seems to suggest that OOPHE in urban areas does not correlate with a households' income. Similarly, the coefficient of wealth (measured by the number of rooms in a household) is significant in the rural setting, but not in the urban model.

Table 7.1. Estimated determinants of OOPHE, based on the 2009NBHS

Dependent variable: logarithm of a household's total healthcare expenditures			
Variable	**Total**	**Rural**	**Urban**
Insurance	-0.343***	-0.109	-0.127
	(0.122)	(0.157)	(0.215)
lnincome	0.206***	0.304***	0.00996
	(0.0422)	(0.0459)	(0.100)
lnage of householdhead	-0.0946	-0.0906	0.512
	(0.160)	(0.171)	(0.397)
Gender	-0.327	-0.331	-0.555
	(0.231)	(0.265)	(0.462)
lnhousehold size	0.502***	0.441***	0.501**
	(0.101)	(0.113)	(0.216)
Primary education	0.138	0.336**	0.127
	(0.117)	(0.144)	(0.206)
Secondary education	0.294	0.564**	0.528*
	(0.196)	(0.272)	(0.299)
Post-secondary education	-0.178	0.0605	-0.208
	(0.851)	(0.941)	(1.815)
University education	0.765**	1.009	1.193***
	(0.324)	(0.632)	(0.414)
No. of under-five children	0.102**	0.0843*	0.123
	(0.0458)	(0.0493)	(0.109)
No. of above-65 members	0.218**	0.112	0.422*
	(0.0942)	(0.100)	(0.235)
Wage employed	0.0980	0.233**	-0.144
	(0.0941)	(0.105)	(0.202)
Wealth	0.0919***	0.137***	0.00948
	(0.0293)	(0.0317)	(0.0684)
Married	0.397	-0.0595	0.446
	(0.264)	(0.344)	(0.441)
Divorced	0.0885	-0.389	0.0845
	(0.431)	(0.507)	(0.911)
Widowed	-0.229	-0.642	-0.369
	(0.362)	(0.455)	(0.639)
Distance	-0.0868**	-0.0149	-0.119
	(0.0413)	(0.0463)	(0.0906)
Constant	0.907	0.687	-0.145
	(0.628)	(0.719)	(1.406)
Observations	1,919	1,412	507
Adj R-squared	0.082	0.15	0.076

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

Unexpectedly, the coefficients of gender and age of the head of household are statistically insignificant in all three models, suggesting that these factors play little role in deciding the amounts of OOPHE paid by households.

In the urban context, the coefficient of the household size is both positive and statistically significant. This suggests that households that have more members are likely to incur higher levels of OOPHE. Moreover, the magnitude of the coefficient of this variable in the urban model (β= 0.501) is higher than the coefficient in the rural sample. This may indicate that increases in rural households push them to incur higher levels of OOPHE in comparison to similar increases in rural households. According to previous literature, many factors may explain this positive correlation (O'Donnell et al. 2005; Cavagnero et al. 2006), and additional justifications may explain this outcome in the Sudanese context. For instance, urban areas are more densely populated than rural areas and members of large households are more likely to live in close quarters. The proximity of individuals in a household to each other likely increases the spread of communicable illness and disease among household members, pushing OOPHE to grow. Moreover, most urban areas in Sudan (even major cities) have severe infrastructure shortages.

Unsurprisingly, as the results reported in Table 7.1 show, educational attainment variables have positive and statistically significant coefficients, indicating the positive association between schooling and OOPHE. However, this correlation varies between the rural and urban setting. Specifically, while the coefficients of the primary and secondary education variables are statistically significant in the rural setting, the secondary and university education variables are statistically significant in urban setting. Nonetheless, this outcome can be explained at least to some extent. Drop-out rates of primary and secondary school are expected to higher in rural than urban settings, which lowers enrollment of individuals in tertiary education. Furthermore, expanding access to tertiary education among urban people would, without doubt, enhance their attitudes towards healthcare matters. It is likely that individuals who have received more educational will spend more on healthcare, since they will have heighten awareness of the negative consequences of continuous morbidity and sickness.

The coefficient of household members under age 5 is statistically insignificant in the urban setting, indicating that the presence of children in a household does not affect OOPHE. Implicitly, this outcome may signify the fact that urban families tend to have fewer children. Put more plainly, urban heads of household are expected to be educated, prioritize the education of health of their household members, hold jobs, and be involved in business activities. Living under such obligations may deter a family from having many children. On the contrary, rural families may not be in circumstances where they are able to prioritize the education and health of their members. Moreover, heads of household in rural areas are expected to have lower educational achievement, are less likely to hold wage employment, and may marry at a young age. Together, these factors may lead rural couples to have more children than urban couples. Consequently, compared to urban households, the high morbidity

that usually characterizes the presence of children younger than 5 may push rural households to allocate larger amounts to OOPHE.

As expected, the coefficient of household members older than 65is positive and statistically significant in the urban sample model, demonstrating that the presence of elderly household members increases the amounts that urban households dedicate to healthcare purchases. This outcome brings further support to the findings of previous studies that find that households with more elderly members spend more on healthcare (O'Donnell et al. 2005; Amaya-Lara 2016).

The results also show that the head of household being wage-employed has no significant correlation with OOPHE paid by urban households. The coefficient in front of the wage employed variable is insignificant, indicating that OOPHE undertaken by those who employed doesn't vary significantly from those who unemployed or hold unsalaried jobs. Similarly, the marital characteristics of the urban household heads appear with no significant effect on OOPHE payments.

Finally, the coefficient of the distance variable in the urban model is statistically insignificant, indicating that the proximity of health care centers plays no role in deciding the amount that urban household pays to obtain health care services.

To give more insight to the analysis, the study takes a further step by disaggregating the urban household samples to the state level. Table 7.2 conveys the OLS estimates of OOPHE's determining factors in the Red Sea, Kassala, Gadarif, Sinnar, and South Darfur states. As the table shows, the coefficient of health insurance is statistically insignificant in all states except South Darfur. This outcome suggests that health insurance coverage is particularly important for urban households in South Darfur. In the same way, income has a negative and statistically significant coefficient only in South Darfur. On the other hand, the coefficients of the head of household's age are positive and statistically significant in both Red Sea and South Darfur. Given that the outcome across all urban data was insignificant (see Table 7.1), this suggests that age may be particularly relevant in these two states.

Interestingly, the coefficient of gender is statistically significant in Red Sea, Gadarif, and South Darfur states, suggesting that, at least in those states, the gender of the head of household corresponds to differences in OOPHE. However, the sign of the coefficient is different among these states. The negative coefficient on the gender variable in Red Sea state indicates that a household with a male head incurs a lower level of OOPHE than a household with a female head. In contrast, the positive coefficients on the gender variable in Gadarif and South Darfur states imply that male-led households spend more on OOPHE than female-led households. This could suggest that female-led households in Gadarif and South Darfur states are more vulnerable to incurring high OOPHE compared than households in the other states under review.

Confirming overall findings reported in Table 7.1, the coefficients of the university education variable in the Red Sea and South Darfur models are positive and statistically significant. This supports previous findings that the advancement in education achievement heightens OOPHE undertaken by both individuals and households.

Table 7.2. Estimated determinants of OOPHE in urban areas by state, based on the 2009NBHS

Variable	Red Sea	Kassala	Gadarif	Sinnar	S. Darfur
Insurance	-0.0445	-1.219	0.607	1.198	-1.229**
	(0.265)	(0.805)	(0.422)	(0.864)	(0.455)
lnincome	0.125	0.207	0.118	0.558	-0.298**
	(0.132)	(0.452)	(0.207)	(0.347)	(0.137)
lnage of household head	1.275**	2.004	-1.160	0.809	1.090*
	(0.528)	(1.631)	(0.740)	(1.303)	(0.559)
Gender	-2.365***	0.693	1.643*	0.177	1.926***
	(0.729)	(0.861)	(0.841)	(1.497)	(0.608)
lnhousehold size	0.218	-0.883	0.0876	-0.486	0.369
	(0.270)	(0.741)	(0.421)	(0.878)	(0.430)
Primary education	0.194	-0.336	-0.146	-0.0800	0.223
	(0.262)	(0.817)	(0.402)	(0.677)	(0.370)
Secondary education	0.438	0.162	0.0403	1.976	0.674
	(0.364)	(1.259)	(0.707)	(1.541)	(0.441)
Post-secondary education	-0.413	-	-	-	-
	(1.786)				
University education	1.114**	-	-0.260	-	2.303***
	(0.483)		(1.169)		(0.602)
No. of under-five children	0.335**	0.251	-0.0275	-0.435	0.651***
	(0.143)	(0.360)	(0.201)	(0.358)	(0.215)
No. of above-65 members	0.229	-0.0490	0.380	0.0217	0.996***
	(0.314)	(0.989)	(0.467)	(0.736)	(0.364)
Wage employed	0.302	2.235***	0.0174	-1.387**	-0.355
	(0.265)	(0.606)	(0.380)	(0.608)	(0.436)
Wealth	-0.0885	-0.150	0.173	-0.377	0.213*
	(0.0910)	(0.403)	(0.139)	(0.281)	(0.119)
Married	0.364	0.118	-0.472	-0.284	-1.315
	(0.525)	(1.838)	(1.134)	(2.260)	(0.968)
Divorced	-0.778	-	-	-	2.070
	(1.108)				(1.350)
Widowed	-2.569***	-0.137	-0.301	-0.937	0.926
	(0.870)	(2.255)	(1.424)	(2.405)	(1.133)
Distance	0.426***	-0.945**	0.0650	0.178	-0.233
	(0.147)	(0.372)	(0.175)	(0.260)	(0.158)
Constant	-3.786**	-2.730	4.720	-0.619	-1.545
	(1.840)	(3.803)	(2.930)	(5.313)	(2.281)
Observations	298	28	89	42	50
Adj R-squared	0.153	0.74	0.21	0.35	0.76

Since the analysis is broken down to the state's level, some commentary elaboration needs to be given to explain this outcome. According to Sudanese health protocols, healthcare services are supposed to be provided for free to children under age 5.Thus, a significant positive coefficient on the variable in

these two states suggests that the health protocols may not be effectively implemented in the urban areas of these states, or that the healthcare services provided by healthcare facilities are very poor.

With regard to the variable of household members older than 65, the disaggregated data shows a significant coefficient only with data from South Darfur state. For this state, the data confirms that urban households with elderly members are likely to incur higher levels of OOPHE and suggests that urban households in South Darfur may experience heavier financial burdens from elderly household members than urban households in other states.

The coefficient of the wage employment variable in Kassala state is positive and statistically significant, indicating that those who hold salaried jobs spend more on OOPHE than those who do not have regular jobs. In contrast, the coefficient of the variable in Sinnar state is negative and statistically significant, suggesting that those who do not have regular jobs spend more on OOPHE. According to the 2009 NBHS, the proportion of the urban population that has wage employment in Kassala state is higher than in the rest of the states under comparison. Furthermore, enrollment in health insurance is compulsory for those who hold regular jobs, but is only voluntary for informal workers. Thus, the positive association between wage employment and OOPHE supports the argument that health insurance does not effectively protect households from incurring OOPHE. This outcome may validate the result obtained from the aggregated urban data, which suggests that health insurance membership does not automatically correspond to lower OOPHE.

Although the coefficient on the wealth variable is insignificant in the aggregated urban data, it is positive and statistically significant in the South Darfur urban context, indicating that, at least in this state, payments of urban households on healthcare are positively related to a household's wealth. Similarly, the coefficient on the distance variable is insignificant when applied to all urban data (although it is significant when applied to aggregated urban and rural data). However, when disaggregating the urban data by state, the coefficient is significant when applied to the Kassala and Red Sea data. Interesting, however, the signs are different. A negative correlation exists in Kassala state, which supports the negative correlation observed in the aggregated urban and rural data: households that live closer to healthcare facilities are likely to incur higher levels of OOPHE. However, the Red Sea urban data shows the opposite correlation. Implicitly, this result may indicate that the distribution of healthcare facilities in urban Kassala is better than those in urban Red Sea. However, the overall conclusion remains that the proximity of healthcare facilities plays a neutral role in the determination of OOPHE incurred by urban residents in the five states under investigation.

7.2. Determinants of OOPHE using 2014's NBHS

Table 7.3 reports the results on determinants of OOPHE incurred by urban households in the selected states, using the 2014 NBHS. The model performs better using 2014 urban household data

than it did using 2009 urban household data. Most of the variables included in the model are statistically significant and display the expected signs.

Starting with the health insurance variable, the coefficients are negative and statistically significant in both the urban and rural setting, which supports the notion that expanding health insurance membership reduces OOPHE paid by urban (as well as rural) households. Interestingly, the coefficient in the urban setting is smaller and has a lower significance level than the coefficient in the rural setting, suggesting that health insurance plays a smaller role in shielding urban households against OOPHE than it does in shielding rural households. This difference could be interpreted in a number of ways. First, health insurance penetration among urban populations in these five states may still be far from the level needed to diminish the speed at which OOPHE grows. Second, the weaker role of the health insurance coverage in reducing OOPHE paid by urban residents may result from inadequate healthcare facilities in urban centers. It is worth mentioning that most urban areas in Sudan are exposed to huge waves of immigration from rural and conflict-affected areas. For instance, during the last two decades, insecurity caused by the armed struggles in South Darfur state has pushed a large portion of the population to immigrate to the state's capital city, Nyala. Similarly, in addition to immigration from rural to urban centers, Kassala and Gadarif states frequently receive high numbers of immigrants from the neighboring countries of Ethiopia and Eritrea. In summary, immigrants to urban areas place great pressure on healthcare facilities in those areas, which may lead individuals to incur higher levels of OOPHE. All these factors are expected to work jointly to make health insurance coverage less effective in mitigating OOPHE being experienced by urban residents.

Nonetheless, there is a flip side to this argument. As mentioned previously, several studies find that increasing health insurance enrollment may push people to incur higher levels of OOPHE. According to Newhouse (1992), Ekman (2007) and Selvaraj and Karan (2012), individuals with health insurance are more likely to obtain checkups and free diagnostic services offered through health insurance windows would likely discover more diseases and illnesses. Compared to uninsured people, who mostly go under-diagnosed, insured people will obtain more healthcare treatment and thus pay higher levels of OOPHE.

Table 7.3. Estimated determinants of OOPHE, based on the 2014 NBHS

Dependent variable: logarithm of a household's total healthcare expenditures			
Variable	**Total**	**Rural**	**Urban**
Health insurance	-0.257***	-0.268***	-0.120*
	(0.0387)	(0.0455)	(0.0693)
lnincome	0.503***	0.487***	0.476***
	(0.0347)	(0.0404)	(0.0625)
lnage of household head	-0.102	-0.0463	-0.260**
	(0.0659)	(0.0765)	(0.123)
Gender	-0.449***	-0.588***	-0.277**
	(0.0786)	(0.0982)	(0.126)
lnhousehold size	0.0224	0.0639	0.00327
	(0.0400)	(0.0487)	(0.0674)
Primary education	0.0366	0.0968*	0.000874
	(0.0481)	(0.0572)	(0.0838)
Secondary education	-0.0375	0.164***	-0.0786
	(0.0464)	(0.0632)	(0.0716)
Post-secondary education	-0.408**	-0.290	-0.321
	(0.192)	(0.401)	(0.219)
University education	0.000652	0.324**	-0.0287
	(0.0901)	(0.159)	(0.114)
No. of under-five children	0.110***	0.124***	0.0101
	(0.0220)	(0.0254)	(0.0407)
No. of above-65 members	0.00374	0.0680	-0.0375
	(0.0389)	(0.0501)	(0.0594)
Wage employed	-0.0966***	-0.0727*	-0.117*
	(0.0369)	(0.0422)	(0.0704)
Wealth	0.202***	0.207***	0.195***
	(0.0116)	(0.0140)	(0.0199)
Married	0.351***	0.281**	0.375***
	(0.0957)	(0.130)	(0.139)
Divorced	0.431***	0.451**	0.386*
	(0.141)	(0.181)	(0.219)
Widowed	0.463***	0.404**	0.457**
	(0.129)	(0.170)	(0.195)
Distance	-0.00228***	-0.00278***	-0.00677***
	(0.000460)	(0.000470)	(0.00181)
Constant	1.041***	1.133***	1.634**
	(0.360)	(0.421)	(0.665)
Observations	2,675	1,835	840
Adj R-squared	0.273	0.320	0.232

*Standard errors in parentheses: ***p < 0.01, **p < 0.05, *p < 0.10.*

The coefficient associated with the income variable is positive and statistically significant in both the urban and rural setting, suggesting that households with a higher income are likely to incur higher levels of OOPHE. This is fairly expected since households with a higher income would be expected to buy more and high quality healthcare services. Put differently, this outcome may indicate that urban (and rural) households with lower incomes may not be able to access more and high quality healthcare services.

Turning to the demographic variables, the coefficient on the age of the head of household head is negative and statistically significant in both settings, but is higher in the urban setting. In other words, households with older heads are likely to incur lower OOPHE. The coefficients associated with the gender variable are negative and statistically significant in both the urban and rural setting. Concisely speaking, this outcome indicates that male-led households spend significantly less on OOPHE than their female-led counterparts. This result might suggest the existence of inequality and gender discrimination among Sudanese communities. Interestingly, even in urban households, which would be expected to have more "enlightened" members and gender equality, female-led households do not seem to perform as well as male-led ones. A number of factors could explain this outcome. First, households led by males are more likely to be affluent and, therefore, have higher access to high-quality healthcare services, and engage in preventive health measures. This would lead to a lower incidence of disease and sickness among the household's members, protecting heads from undertaking higher OOPHE. In contrast, deeply rooted prejudices against females may trap female-headed households in a vicious circle of poverty and, consequently, make it more difficult for them to obtain life and health-sustaining services. Accordingly, female-led households may pay higher levels of OOPHE. It is worth mentioning that in the Sudanese context women are exposed to extreme discrimination in the labor market and are usually unemployed or underemployed. In particular, in urban areas, Sudanese women hold marginalized jobs such as selling tea and foods in the streets, working as housekeepers, or making handcrafts. These jobs are irregular and provide women with lower earnings, making female-led households subject to fragile livelihoods and poor health conditions. Interestingly, the coefficient on gender variable in the urban setting is smaller than the coefficient on the rural setting. This may suggest that Sudanese families living in urban communities experience less gender discrimination than those in rural communities.

The coefficients associated with the household size variable are statistically insignificant in both the urban and rural settings, indicating an absence of association between increases in the number of household members and OOPHE. This observation diverges from prior literature suggesting that larger households are likely to have higher levels of OOPHE. For example, Van Doorslaer et al. (2005) argue that the large size of the household increases the probability of contracting more diseases among members, particularly in the case of contagious diseases. Nevertheless, this outcome can be interpreted based on the fact that the majority of the population in Sudan fall in the category of young age and, thus, has lesser likelihood of getting sick. According to the 2014 NBHS, the average age of households in urban areas is only 46 years indicating that the majority of population belongs to the youth and, thus, less likely to pay larger OOPHE.

Interestingly, the coefficient on the variable reflecting members of the household younger than 5 is significant in the rural setting but insignificant in the urban setting, suggesting that having young children is not likely to impact an urban family's OOPHE. This may be due to the fact that young

children in Sudan are entitled to free healthcare (Ebaidalla and Ali 2019), although that healthcare may be more difficult to obtain in rural settings.

On the whole, the insignificance of the majority of the demographic variables may indicate that the demographic characteristics of urban households are not related to the incidence of OOPHE incurred by urban households in these selected states. Similarly, educational attainment variables do not performing well when looking at the 2014 urban household data. The coefficients of these variables in the urban setting carry the correct sign, but are all statistically insignificant. This outcome diverges from findings in previous studies (Grossman 1999; Cowell 2006), which argue that OOPHE is highly influenced by the educational achievement of the head of household.

The coefficients of the wage employment variable are negative and statistically significant in both the urban and rural setting, indicating that households led by individuals with wage employment incur a lower level of OOPHE than those led by individuals who are informally employed. On the other hand, the coefficients associated with the wealth variable are positive and statistically significant in both settings, indicating that wealthier households incur a higher level of OOPHE. The explanation for this outcome is straightforward, since wealthier households tend to demand more and higher quality healthcare. However, this outcome differs from the outcome based on 2009 NBHS, which found the coefficient of wealth variable statistically insignificant. One possible interpretation for this difference may be that urban Sudanese households became more affluent in 2014 compared to 2009. This conclusion can be supported by the statistics of the 2014's NBHS according to which the poverty incidence among Sudanese population is found to be 36.1% which is considerably less than 46.5% reported in 2009's NBHS.

The coefficients associated with social variables such as being married, divorced, or widowed are positive and statistically significant in both urban and rural settings, suggesting that marriage (even if it ends in divorce or widowhood) is correlated with higher levels of OOPHE. However, the magnitudes of the coefficients for the married and widowed variables in the urban model are higher than the coefficients in the rural model. In contrast, the coefficient for the divorced variable is lower in the urban model than in the rural model, suggesting that urban households led by a divorced head spend less on OOPHE than their rural counterparts.

Finally, the coefficients of the distance variable are negative and statistically significant in the urban and rural settings. In other words, increasing the distance to healthcare facilities decreases OOPHE. This outcome may be due to the fact that healthcare facilities in urban areas are fairly distributed. Put differently, the negative correlation between distance and OOPHE may suggest that when a household lives far from healthcare facilities, it is less likely to bring sick members to health consultancies and, therefore, will incur lower levels of OOPHE.

To give more robustness to the above results, the urban household data is disaggregated and reported by state in Table 7.4. The coefficients of the insurance variable in the five models under consideration are all statistically insignificant, although this may simply be due to the smaller sized data sets. Similarly, with the exception of the wealth variable in Kassala, economic characteristics such as income, wage employment, and wealth appear with no significant influence on OOPHE among urban households when the data is disaggregated. In a similar vein, the age of the head of household is insignificant, except in Red Sea (where it is negative and statistically significant). The coefficient of the gender variable in Table 7.4 is also insignificant. This outcome is likely due to the smaller sized data sets used when the data is disaggregated.

Interestingly, although household size is not significant in the aggregated urban data, it has a negative and statistically significant coefficient in the Gadarif data, suggesting that, at least in the urban areas of this state, having more household members lowers the amount of OOPHE spent.

The relationship between the educational level of household head and OOPHE is inconsistent between the states. In South Darfur, there is no correlation between educational level of the head of household and OOPHE, in Red Sea only post-secondary education has a significant (negative) relationship. Both primary and secondary educational attainment correlate with OOPHE in Gadarif and Sinnar states, but the relationship is negative in Gadarif and positive in Sinnar.

Attending tertiary education is found to have a positive and significant effect on OOPHE incurred by urban households in Kassala and Sinnar states. This agrees in part with the outcome that emerges from the disaggregated 2009 NBHS data. The 2009 data shows that the head of household attending university corresponds to increased OOPHE incurred by urban households in Red Sea and South Darfur states, while the 2014 data shows that this outcome only in Kassala and Sinnar states.

Table 7.4.Estimated determinants of OOPHE in urban areas by state, based on the 2014 NBHS

Dependent variable: logarithm of a household's total healthcare expenditures					
Variable	**Red Sea**	**Kassala**	**Gadarif**	**Sinnar**	**S. Darfur**
Health insurance	-0.0237	-0.00427	-0.00455	-0.00152	0.00313
	(0.0146)	(0.00961)	(0.00595)	(0.00644)	(0.0133)
lnincome	0.00475	0.0115	-0.00121	-0.00275	0.00111
	(0.0116)	(0.00825)	(0.00670)	(0.00601)	(0.0136)
lnage of household head	-0.0709***	0.00121	0.00997	-0.0148	-0.0124
	(0.0249)	(0.0157)	(0.0140)	(0.0104)	(0.0223)
Gender	-0.0272	0.0245	0.0135	0.0190	0.0123
	(0.0311)	(0.0177)	(0.00960)	(0.0149)	(0.0208)
lnhousehold size	-0.0191	0.0134	-0.0171**	-0.000571	-0.00885
	(0.0138)	(0.00853)	(0.00672)	(0.00591)	(0.0131)
Primary education	-0.00349	0.00519	-0.0202**	0.0141*	0.00947
	(0.0174)	(0.00960)	(0.00935)	(0.00723)	(0.0152)
Secondary education	-0.00487	0.0132	-0.0153**	0.0171***	0.00935
	(0.0136)	(0.00943)	(0.00759)	(0.00634)	(0.0134)
Post-secondary education	-0.0974**	0.0216	0.00137	0.0145	-0.0304
	(0.0386)	(0.0283)	(0.0202)	(0.0205)	(0.0606)
University education	-0.0235	0.0257*	-0.0189	0.0170*	-0.0251
	(0.0234)	(0.0130)	(0.0130)	(0.0102)	(0.0217)
No. of under-five children	0.00881	0.00326	0.00518	-0.00156	0.000608
	(0.00884)	(0.00439)	(0.00444)	(0.00365)	(0.00699)
No. of above-65 members	-0.00451	0.00290	-0.00458	0.00634	0.0112
	(0.0107)	(0.00749)	(0.00628)	(0.00508)	(0.0147)
Wage employed	0.00663	-0.00638	0.00380	-0.000471	-0.000724
	(0.0150)	(0.00979)	(0.00639)	(0.00638)	(0.0130)
Wealth	0.0119	-0.0150**	-0.00441	0.00205	0.00156
	(0.0127)	(0.00726)	(0.00294)	(0.00136)	(0.00340)
Married	-0.00749	-0.00248	-0.00234	0.0160	0.0440
	(0.0238)	(0.0157)	(0.0191)	(0.0119)	(0.0474)
Divorced	-0.0781*	-0.00955	0.00207	0.0258	0.0891
	(0.0398)	(0.0303)	(0.0242)	(0.0266)	(0.0539)
Widowed	-0.0266	0.0136	0.00136	0.0222	0.0528
	(0.0365)	(0.0275)	(0.0243)	(0.0190)	(0.0518)
Distance	0.000437	-0.000121	-0.00029**	-0.00063**	-9.71e-05
	(0.000346)	(0.000495)	(0.000142)	(0.000293)	(0.000324)
Constant	3.985***	4.045***	4.383***	5.176***	6.295***
	(0.130)	(0.0873)	(0.0717)	(0.0590)	(0.135)
Observations	280	151	141	129	138
Adj R-squared	0.123	0.122	0.224	0.207	0.068

*Standard errors in parentheses: ***p < 0.01, **p < 0.05, *p < 0.10.*

The coefficients associated with under-five and over 65 variables are statistically insignificant, which agrees with the aggregated urban data from 2014. Similarly, the marital characteristics of heads of household have no significant relationship to OOPHE when the state-level data is used.

Finally, the coefficient of distance variable in both Gadarif and Sinnar models is negative and statistically significant ratifying the outcome observed in the aggregated urban data.

7.3. Determinants of OOPHE according to gender

Table 7.5 below reports the results of determining factors of OOPHE incurred by urban households according to gender of household. The findings based on the 2009 NBHS do not depart considerably from those emerged from using aggregated urban data. However, disaggregating the data according to gender highlights some interesting differences.

For instance, the coefficients of variables such as health insurance, income, and age reported for the 2009 data are all statistically insignificant, indicating the absence of correlation between OOPHE and these factors when the data is disaggregated according to gender. This is likely due to the fact that there are fewer households led by women, which means the samples are not large enough to create statistically significant findings.

On the other hand, a number of coefficients are statistically significant when based on the male-led households. For example, the coefficient of the household size variable in male-led households in 2009 is positive and statistically significant, indicating that OOPHE incurred by male-led households is positively correlated with the size of the family. The coefficient of this same variable is insignificant for female-led households in 2009, likely due to the fact that the data set only includes 40 such households. Replicating the results obtained with the aggregated urban data from 2009, the data relating to male-led urban households confirms that educational attainment plays a significant role in the amount of OOPHE incurred by a household. However, this conclusion does not hold for data relating to female-led urban households.

The coefficients associated with the variables regarding household members younger than 5 or older than 65 are statistically insignificant in the data relating to female-led households. However, the coefficient associated with variable of household's members older than 65 is positive and statistically significant in the data relating to male-led households, indicating that households with elderly members are more likely to incur higher levels of OOPHE.

Interestingly, the coefficient of the wealth variable for female-led households in 2009 is positive and statistically significant, which suggests that improving wealth status leads to more spending on OOPHE by female-led households. On the other hand, the coefficients related to marital status are insignificant for both male- and female-led households in 2009, indicating that these social characteristics have no impact on OOPHE when households are disaggregated by gender.

Turning to the analysis based on the 2014 NBHS, most of the variables' coefficients diverge according to the gender of the head of household. However, some variables are consistent with the 2009 data and continue to play a neutral effect on OOPHE. For instance, the coefficients on the health insurance variable are insignificant for both genders in both 2009 and 2014. This suggests that health insurance membership has no impact on OOPHE when urban data disaggregated by the gender of the head of household. By the same token, the coefficient associated with the age of the head of

household variable is statistically insignificant, indicating that age does not have impact on the amount of OOPHE to be paid by urban households.

Table 7.5. Determinants of OOPHE in urban areas according to gender

Dependent variable: logarithmof a household's total healthcare expenditures				
	2009		2014	
Variable	Female	Male	Female	Male
Insurance	1.112	-0.175	0.0592	-0.118
	(0.899)	(0.224)	(0.201)	(0.0747)
lnincome	-0.0780	0.0108	0.609***	0.463***
	(0.276)	(0.109)	(0.230)	(0.0650)
lnage of household head	2.062	0.528	-0.215	-0.213
	(1.804)	(0.416)	(0.434)	(0.130)
lnhousehold size	0.759	0.465**	0.321*	-0.0670
	(0.780)	(0.233)	(0.185)	(0.0735)
Primary education	-0.0113	0.152	-0.791**	0.0563
	(0.874)	(0.214)	(0.332)	(0.0868)
Secondary education	-1.594	0.579*	-0.364	-0.0380
	(1.431)	(0.309)	(0.295)	(0.0740)
Post-secondary education	-	-0.143	-0.594	-0.208
		(1.838)	(0.581)	(0.240)
University education	1.774	1.015**	-0.937**	0.0735
	(1.508)	(0.446)	(0.394)	(0.120)
No. of under-five children	0.185	0.128	0.0249	0.0188
	(0.430)	(0.114)	(0.167)	(0.0422)
No. of above-65 members	-0.120	0.432*	-0.193	-0.00438
	(0.825)	(0.252)	(0.187)	(0.0630)
Wage employed	-0.975	-0.124	0.0320	-0.132*
	(0.729)	(0.213)	(0.208)	(0.0763)
Wealth	0.509*	-0.0180	0.257***	0.183***
	(0.286)	(0.0717)	(0.0595)	(0.0211)
Married	-2.299	0.588	0.634	0.328**
	(2.167)	(0.463)	(0.486)	(0.146)
Divorced	-1.003	-1.653	0.896*	-0.118
	(2.100)	(1.892)	(0.487)	(0.426)
Widowed	-2.951	0.00300	0.646	0.426*
	(2.091)	(0.807)	(0.496)	(0.256)
Distance	-0.189	-0.104	-0.00730	-0.00683***
	(0.334)	(0.0958)	(0.00504)	(0.00195)
Constant	-4.823	-0.801	-0.450	1.433**
	(6.201)	(1.476)	(2.615)	(0.679)
Observations	40	467	95	745
Adj R-squared	0.59	0.069	0.478	0.195

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

In contrast, the 2014 data leads to positive and statistically significant coefficients on income for both male- and female-led households.

Although the coefficient on the variable of household size is insignificant for male-led households in 2014, it is positive and statistically significant for female-led households, indicating that female-led urban households with more members pay higher levels of OOPHE. Interestingly, the coefficients

associated with the primary and university education variables in the female model are negative and statistically significant, suggesting that a household with a female head who has attending primary school or university pays a lower level of OOPHE than a household led by an uneducated woman. In contrast, the coefficient of the wage employment variable is negative and statistically significant for male-led households, suggesting that households with male leaders holding regular jobs spend less on OOPHE than those with leaders in irregular employment. However, for female-led urban households, the coefficient on the variable is statistically insignificant indicating that being wage employed has no influence on the OOPHE incurred by female-led households. Given the fact that females represent about 49% of the total Sudanese population (World Bank, 2020), the insignificance of this factor may indicate that women are underrepresented in formal labor markets.

As with female-led households in 2009, the coefficients associated with the wealth variable in 2014 are positive and statistically significant for both male- and female-led urban households, indicating that having more wealth is related to paying more in OOPHE. This outcome may point towards the importance of wealth accumulation in deciding OOPHE paid by urban households. In particular, the positive coefficients associated with the wealth variable in the female model in both 2009 and 2014 NBHS surveys confirm the critical contribution of females' empowerment in raising health care services utilization among female-headed households.

The coefficient of the married variable is positive and statistically significant in male-led urban households in 2014, indicating that households led by a married man spend more on OOPHE than households led by men with other marital statuses. Slightly different, the coefficient of the divorced variable is positive and statistically significant for female-led households in 2014, showing that households led by a female divorcée spend more on OOPHE than households led by women with other marital statuses. This result suggests that divorced women may be more vulnerable to the burden of OOPHE, perhaps because they are left with children.

On the whole, the large number of statistically significant variables relating to both male- and female-led households suggests that gender alone may play a role in determining the amount of OOPHE spent by urban households in the states under consideration.

7.4. Determinants of CHE in the selected states using the 2009 NBHS

Table 7.6 reports the estimates of the probit model on the determinants of CHE incurred by urban households in Red Sea, Kassala, Gadarif, Sinnar and South Darfur states at 10%, 20%, and 30% thresholds. As can be seen from reported results, the coefficients of many of the variables in these three specifications are insignificant. For example, the coefficient of the health insurance variable in all three thresholds is insignificant, indicating that health insurance membership may not affect the likelihood of incurring CHE.

Nonetheless, in contrast with the outcome emerging from the10% and 20% thresholds, the coefficient of the household head age variable in the 30% threshold model is positive and statistically significant. This outcome demonstrates that aging of heads boosts the likelihood of incurring CHE that equals to or exceeds a 30% of non-food household expenses.

The coefficient on the household size variable is negative and statistically significant for the 30% threshold, indicating that a household with more members is less likely to incur CHE reaching or exceeding30% of non-food expenditures.

The reported results also indicate that the above 65 member variable has a positive and statistically significant coefficient in the 10% threshold model, while it has a negative but significant coefficient in the 30% threshold model. These outcomes indicate that the presence of elderly among urban household's members increases the odds of undertaking CHE that equals to or exceeding the 10% threshold, but may lower the odds of incurring CHE equal to or exceeding the30% threshold.

Table 7.6.Estimates of probit models on determinants of CHE Using 2009's NBHS:

Dependent variable : CHE			
Variable	**Threshold**		
	Cat 10	**Cat20**	**Cat30**
Health insurance	-0.0903	-0.0914	-0.167
	(0.155)	(0.183)	(0.226)
lnincome	-0.0849	-0.0756	-0.0565
	(0.0731)	(0.0832)	(0.103)
lnage of household head	0.235	0.293	1.145***
	(0.285)	(0.322)	(0.422)
Gender	-0.306	0.114	0.166
	(0.340)	(0.391)	(0.523)
lnhousehold size	-0.101	-0.266	-0.548**
	(0.157)	(0.176)	(0.220)
Primary education	-0.190	0.126	0.0622
	(0.150)	(0.167)	(0.217)
Secondary education	-0.110	0.0135	0.136
	(0.218)	(0.255)	(0.307)
Post-secondary education	-	-	-
University education	0.184	-0.0200	0.391
	(0.299)	(0.370)	(0.394)
No. of under-five children	0.118	0.0343	0.107
	(0.0786)	(0.0904)	(0.112)
No. of above-65 members	0.279*	-0.0210	-0.511*
	(0.167)	(0.193)	(0.287)
Wage employed	-0.0136	-0.179	-0.0436
	(0.145)	(0.169)	(0.208)
Number of room	0.00505	-0.0217	-0.0546
	(0.0492)	(0.0568)	(0.0715)
Married	0.143	0.288	-0.429
	(0.329)	(0.423)	(0.460)
Divorced	0.569	0.187	-
	(0.655)	(0.786)	
Widowed	-0.703	0.108	-0.977
	(0.478)	(0.561)	(0.687)
Distance	0.00161	0.0950	-0.00784
	(0.0652)	(0.0765)	(0.0930)
Constant	-0.436	-1.676	-4.008***
	(1.020)	(1.186)	(1.506)
Observations	506	506	500
Pseudo R^2	0.028	0.025	0.05

*Standard errors in parentheses: ***p < 0.01, **p < 0.05, *p < 0.10.*

The rest of the demographic and social characteristics of the household heads such as gender, education and the presence of children among household members appear to have no significant effect on the probabilities of incurring CHE above threshold levels.

In contrast with prior expectations, the coefficients associated with income, wage employment, and wealth variables are all insignificant, indicating that holding a salaried job or being wealthier exercises no effect on the likelihood of incurring CHE at these defined thresholds. The same conclusion can

be drawn for the marital status variables. The coefficients associated with these variables are all statistically insignificant, suggesting that having a married, divorced, or widowed head of household should not affect an urban household's likelihood of incurring CHE.

Finally, the coefficient of the distance variable is statistically insignificant for all three thresholds, indicating that the travelled distance to health facilities doesn't affect the probability incurring that CHE. This finding is, to some extent, agrees with the outcome obtained in OOPHE's estimation in which the distance variable is found to be negative and statistically significant. It may also support the suggestion that healthcare services facilities in these states are fairly and proximately distributed in the urban centers.

In summary, based on the above results one can conclude that the CHE incurred by an urban household in the selected states is, to a large extent, not affected by demographic, social, economic, and marital characteristics. Alternatively stated, the pattern of CHE may be driven by other factors, such as environmental characteristics in the urban areas, morbidity rates, and the prevalence of chronic diseases among urban households' members.

7.5. Determinants of CHE in the selected states using the 2014 NBHS

Table 7.7 displays probit estimates on factors that may push urban households in the states under consideration to incur CHE using the 2014 NBHS. Similar to the analysis based on the 2009 NBHS, the CHE has been defined using 10%, 20% and 30% thresholds. A look at the results leads us to conclude that the model seems to behave well to those reported in Table 7.6 as the majority of the variables are significant and display the expected signs.

For instance, the coefficient of the health insurance variable is negative and statistically significant at the10% threshold, implying that having health insurance reduces the probability of incurring CHE at a threshold of 10%. This gives a great support to literature stating that health insurance prevents enrollees from exposure to the risk of CHE (Xu et al. 2003; Galárraga et al. 2010; Lara and Gómez, 2011). It also ratifies the results in Tables 7.3 and 7.4, which indicate that health insurance membership corresponds to lower levels of OOPHE. However, this conclusion cannot be generalized to the models based on 20% and 30% thresholds. As reported in column three, the coefficient of the variable turns out to be is insignificant, indicating that being insured plays no role in lowering the odds of undertaking CHE at 20% thresholds. This result suggests that health insurance membership becomes functionless when an urban household exposes to CHE exceeding 10%. In the same way, the positive and significant coefficient on the variable for the 30% threshold indicates that health insurance membership increases the likelihood of incurring CHE. Read together with the results belong to the insurance variable in column three, this outcome indicates the powerless of health insurance membership in shrinking the high amount of CHE.

Agreeing with prior expectations, the coefficients associated with income variable in columns three and four are positive and statistically significant, indicating that increases in income heighten the probability of undertaking CHE at 20% and 30% cut-offs. One possible interpretation for this outcome is that increases in monetary incomes are likely to motivate households to devote larger portions of their budget to healthcare. Another possible interpretation may be that urban households with a higher income adopt lifestyles that are more likely lead to chronic diseases, such as diabetes, hypertension, and cancer. Dealing with such diseases would certainly increase OOPHE among urban households, pushing them towards catastrophic frontiers. The coefficients associated with the wealth variable at the 10% and 20% thresholds are positive and statistically significant demonstrating that being a wealthy urban household increases the likelihood of spending CHE reaching 10% and 20% of non-food expenditures. Overall, the outcomes emerging from the income and wealth variables confirm the key role of prosperity in driving households to spend more on healthcare.

Unpredictably, the coefficients of the age and gender variables are statistically insignificant across the three defined thresholds. These outcomes may indicate that the demographic variables play no role in deciding the likelihood of undertaking CHE. In the same line of unpredicted outcome, the coefficients of the under-five and above 65 variables in the three thresholds models are statistically insignificant. This indicates that hosting under-five and above-65 among household members play no role in deciding the odds of incurring CHE.

Table 7.7.Estimates of probit models on determinants of CHE using 2014's NBHS:

Dependent variable : CHE			
	Threshold		
Variable	**Cat 10**	**Cat20**	**Cat30**
Health insurance	-0.264**	-0.172	0.378*
	(0.117)	(0.162)	(0.196)
Lnincome	0.0450	0.418***	0.612***
	(0.107)	(0.154)	(0.178)
lnage of household head	-0.289	0.0865	0.278
	(0.208)	(0.288)	(0.347)
Gender	-0.252	-0.305	0.348
	(0.214)	(0.272)	(0.344)
lnhousehold size	-0.137	-0.0348	0.647***
	(0.115)	(0.158)	(0.195)
Primary education	-0.0323	-0.120	0.192
	(0.141)	(0.200)	(0.254)
Secondary education	-0.221*	-0.0814	0.140
	(0.122)	(0.167)	(0.197)
Post-secondary education	-0.722*	-	-
	(0.413)		
University education	-0.190	0.269	0.627
	(0.193)	(0.244)	(0.385)
No. of under-five children	0.0163	0.0304	0.0697
	(0.0690)	(0.0930)	(0.135)
No. of above-65 members	0.00796	-0.124	0.280
	(0.102)	(0.150)	(0.216)
Wage employed	-0.0542	-0.305*	-0.192
	(0.117)	(0.159)	(0.198)
Wealth	0.255***	0.226***	0.00104
	(0.0366)	(0.0441)	(0.0679)
Married	0.582**	0.380	-0.196
	(0.263)	(0.419)	(0.395)
Divorced	0.294	0.678	0.543
	(0.395)	(0.545)	(0.633)
Widowed	0.531	0.675	0.399
	(0.347)	(0.499)	(0.582)
Distance	-0.00865***	-0.00498	0.00301
	(0.00325)	(0.00451)	(0.00582)
Constant	-0.0917	-5.168***	-5.517***
	(1.127)	(1.634)	(1.934)
Observations	840	825	825
Pseudo R	0.09	0.14	0.13

*Standard errors in parentheses: ***p < 0.01, **p < 0.05, *p < 0.10*

This result may be due to the fact that the number of household members younger than 5 or older than 65 among the urban households surveyed is quite low. According to the 2014 NBHS, 59.91% of urban households had no children younger than 5 and 26.51% of urban households had only 1 child under age 5 at the time they were surveyed. No doubt, such household's composition makes these variables have a negligible impact on CHE incurred by urban households.

The most interesting outcome is that the coefficient of the household size variable is positive with a high level of significance at the 30% threshold. This outcome indicates that increases in household size correlate to a higher likelihood that an urban household will incur CHE equal to or exceeding 30% of non-food expenditures. Repeating the argument proposed to justify the correlation between a household's income and CHE, the higher CHE is probably driven by exposure to chronic diseases resulting from unhealthy lifestyle that adopted by urban residents. The 2009 Households Health Utilization and Expenditure Survey documents that compared to rural households, urban households experience many chronic diseases, such as diabetes, hypertension, cancer, and asthma (Sudan Federal Ministry of Health, 2009). This reality would definitely increase CHE incurred by households with chronically ill members.

As anticipated, educational attainment seems to play an important role in protecting urban households from CHE at the10% threshold. However, this desirable contribution of education is mainly restricted to secondary and post-secondary schooling. Specifically, the coefficients of these two variables at the 10% threshold are negative and statistically significant, indicating that attending these levels of schooling lowers the likelihood of encountering CHE. This suggests the importance of the contribution of education to the reduction of CHE.

Similar to results obtained using the OOPHE model, the coefficient of the married variable is positive and statistically significant at the 10% threshold, indicating that households with a married head are more likely to incur CHE at the 10% threshold. Conversely, the coefficients associated with the divorced and widowed variables are statistically insignificant.

Unexpectedly, the coefficient of the distance variable at the 10% threshold is negative and statistically significant. This finding indicates that living further from healthcare facilities pulls down the probability of incurring CHE among urban residents. Obviously, this outcome contradicts common sense and, thus, needs some justification. First, the analysis undertaken by this study is confined to the urban centers in Red Sea, Kassala, Gadarif, Sinnar, and South Darfur states. Due to the high population densities in these states' urban centers, healthcare facilities and medical windows are expected to be fairly distributed in these areas, mitigating against incurring CHE. In other words, the distance reported in the survey was not far that it significantly increased healthcare spending by urban dwellers. Second, the proximity of healthcare facilities and accessibility to well-trained medical practitioners, which characterizes most urban areas, assists greatly in achieving timely diagnosis and mitigation of diseases, therefore, decreases the likelihood of reaching CHE levels. Alternatively stated, equitable distribution of healthcare facilities in urban centers weakens the impact of distance on a household's healthcare expenditures.

7.6. Impact of CHE on urban households' livelihoods

As mentioned in the methodology section, this study examines the impact of healthcare spending on the livelihoods of urban households in the selected states by estimating the role of CHE in lowering the shares of a household's food and non-food purchases in its total expenditures. Table 7.8 reports estimates of the model depicting the impact of CHE on the share of a household's budget devoted to purchase foods items (equation (4) above).

As the table shows, the share of food purchases in a household's budget is negatively affected by CHE. Specifically, the share of food in a household's budget is negatively related to the rates of CHE an urban household incurs. For instance, the coefficient of the CHE variable based on the 2009 NBHS data is negative and statistically significant in all chosen thresholds. In contrast, the coefficient of the CHE variable based on the 2014 NBHS data set has no significant effect on a household's food purchases. However, the coefficient of the CHE variable in column seventh shows, the CHE at a 30% threshold, suggesting that CHE at this level leads to significant reductions in the amount a household can allocate to purchasing food.

The slight divergence between the results in 2009 and 2014 may imply that urban households in these five states became more affluent in 2014 than they were in 2009. In other words, there may have been significant improvements in household's livelihoods between these two years. This claim can be further defended by looking at the magnitudes of the coefficient for CHE in 2009 versus in 2014. Moreover, the insignificant effects of CHE at the 10% and 20% thresholds in 2014 may be attributed, in part, to progress achieved on the front of health insurance coverage. Alternatively stated, between 2009 and 2014 many households were brought under the umbrella of health insurance, either through voluntary enrollment or by official institutions and charities, including Chamber of Zakat, the Federal Ministry of Finance, and NGOs.

Table 7.8. Impact of CHE on urban households' food purchases in selected states, 2009 and 2014

Dependent variable:Foodexpenditure (% of total Expenditure)						
	2009's NBHS			2014's NBHS		
Threshold	10%	20%	30%	10%	20%	30%
CHE	-0.0258***	-0.0341***	-0.0654***	0.00441	0.0176	-0.211***
	(0.00807)	(0.00980)	(0.0134)	(0.00965)	(0.0149)	(0.00880)
lnincome	-0.00326	-0.00344	-0.00389	-0.00553	-0.00663	0.000684
	(0.00493)	(0.00492)	(0.00489)	(0.00937)	(0.00941)	(0.00719)
lnlage	0.00810	0.00762	0.0116	0.00260	0.00222	0.000403
	(0.0187)	(0.0187)	(0.0186)	(0.0185)	(0.0185)	(0.0142)
Gender	0.0715***	0.0748***	0.0729***	0.0211	0.0219	0.00232
	(0.0223)	(0.0222)	(0.0220)	(0.0188)	(0.0188)	(0.0144)
lnhouseholdsize	-0.0400***	-0.0414***	-0.0413***	0.0172*	0.0170*	-0.0706***
	(0.0102)	(0.0102)	(0.0101)	(0.0101)	(0.0100)	(0.00853)
Children	0.00597	0.00570	0.00525	0.00636	0.00632	0.00769
	(0.00522)	(0.00521)	(0.00517)	(0.00609)	(0.00609)	(0.00467)
Elderly	0.00229	0.00122	0.000664	-0.0165*	-0.0161*	-0.00416
	(0.0100)	(0.0100)	(0.00994)	(0.00890)	(0.00890)	(0.00685)
Married	-0.00609	-0.00586	-0.00769	-0.0237	-0.0237	-0.0190
	(0.0197)	(0.0197)	(0.0196)	(0.0209)	(0.0208)	(0.0160)
Divorced	0.0637	0.0611	0.0585	-0.0236	-0.0250	-0.0431*
	(0.0462)	(0.0461)	(0.0458)	(0.0328)	(0.0328)	(0.0252)
Widowed	-0.00268	0.00104	-0.00372	-0.0267	-0.0281	-0.0413*
	(0.0308)	(0.0307)	(0.0306)	(0.0292)	(0.0292)	(0.0224)
Primary	-0.0204**	-0.0192*	-0.0189*	-0.0127	-0.0124	-0.0151
	(0.00994)	(0.00993)	(0.00987)	(0.0124)	(0.0124)	(0.00953)
Secondary	-0.0324**	-0.0309**	-0.0290**	-0.0205*	-0.0206*	-0.0176**
	(0.0128)	(0.0128)	(0.0128)	(0.0106)	(0.0105)	(0.00808)
Post-secondary	-0.0931	-0.0942	-0.0931	-0.0732**	-0.0724**	-0.0180
	(0.0610)	(0.0610)	(0.0606)	(0.0326)	(0.0326)	(0.0251)
University	-0.0335**	-0.0345**	-0.0327**	-0.0300*	-0.0310*	-0.0549***
	(0.0164)	(0.0164)	(0.0163)	(0.0168)	(0.0168)	(0.0129)
Wage employed	0.0171**	0.0164**	0.0179**	0.0110	0.0119	0.0160**
	(0.00807)	(0.00807)	(0.00800)	(0.00896)	(0.00898)	(0.00685)
Wealth	-0.00734**	-0.00763***	-0.00775***	-0.00179	-0.00213	-0.000786
	(0.00285)	(0.00285)	(0.00283)	(0.00306)	(0.00302)	(0.00228)
Constant	0.667***	0.666***	0.655***	0.619***	0.628***	0.807***
	(0.0679)	(0.0678)	(0.0674)	(0.0991)	(0.0992)	(0.0764)
Observations	922	922	922	840	840	840
R-squared	0.085	0.087	0.098	0.028	0.029	0.428

It is worth mentioning that several studies document that insured households experience less CHE than uninsured households (Banthin and Selden 2003; Davidoff, Kenney, and Dubay 2005; Leininger et al., 2010; Finkelstein et al. 2012; McMorrow et al. 2016). In addition, the benefits of health insurance coverage in reducing financial risk, and thus the negative consequences on livelihoods, are likely to work indirectly through improvements to an individual's health. Quasi-experimental studies by the Oregon Health Insurance Experiment show that health insurance increases healthcare utilization, improves general health status, and reduces mortality rates among low-income adults (Aizer and Grogger, 2003; Sommers et al., 2012).

On the whole, since the share of food in a household's budget is negatively correlated to CHE at the 30% threshold in both rounds of NBHS, it can be concluded that this branch of healthcare spending exacerbates urban households' livelihoods in the five states under investigation and, as a consequence, pushes urban population into the poverty trap.

The next step in analyzing the impact of healthcare expenditures on the livelihoods of urban households is done by examining CHE impact on the share of the non-food expenditures. Table 7.9 reports the estimates of equation (4), which examines the influence of CHE on the share of non-food expenditures in a household's total expenditures, using 2009 and 2014 NBHS surveys. The coefficients of the CHE variable for 2009 are negative and statistically significant at all threshold levels. This indicates that increases in the rates of CHE correspond to a negative impact on the ability of an urban household to purchase non-foods items, such as clothes, durable goods, and other housing supplies (each of which has a direct impact on a household's poverty status). However, and similar to the impact of CHE on the share of food purchases in total spending, the estimates based on the 2014 NBHS survey indicate that incurring CHE up to 20% threshold has no significant correlation with the share. This can be indicated by the existence of insignificant coefficients associated with the CHE variable at the 10% and 20% thresholds. However, the situation is different at the30% threshold, where the coefficient of the CHE variable is negative and statistically significant. This indicates that starting from this threshold; CHE reduces the share of non-food spending in an urban household's budget.

In the urban context, reducing the share of non-food items in total expenditures is likely to negatively impact the household's welfare. This is because, compared to rural residents, those who reside in urban areas purchase more life's sustaining items, such as sanitation inputs and housing supplies. Due to the high population density that characterizes most urban areas, a failure to purchase sufficient quantities of such items may result in poor housing conditions, pushing household members into poverty and creating even more negative health outcomes. Furthermore, the states under investigation are frequently exposed to outbreaks of endemic diseases such as malaria, chikungunya, and typhoid. The high population density in urban areas in these states accelerates infection rates, pushing households to incur even higher healthcare expenditures. In most cases, outbreaks of these diseases cause financial shocks to urban households, thus deteriorating livelihoods.

Table 7.9. Impact of CHE on urban households' non-food purchases in selected states, 2009 and 2014

Dependent variable: non-foodexpenditure (% of total expenditures)						
	2009's NBHS			2014's NBHS		
Threshold	10%	20%	30%	10%	20%	30%
CHE	-0.0546***	-0.0735***	-0.0877***	-0.00611	-0.00426	-0.0185***
	(0.00666)	(0.00803)	(0.0112)	(0.00582)	(0.00899)	(0.00689)
lnincome	0.00308	0.00272	0.00202	-0.000304	-0.000153	9.20e-05
	(0.00406)	(0.00403)	(0.00408)	(0.00565)	(0.00568)	(0.00563)
lnage	-0.0141	-0.0151	-0.0113	0.00594	0.00650	0.00635
	(0.0155)	(0.0153)	(0.0155)	(0.0112)	(0.0111)	(0.0111)
Gender	-0.0479***	-0.0410**	-0.0419**	-0.00351	-0.00332	-0.00464
	(0.0184)	(0.0182)	(0.0184)	(0.0113)	(0.0114)	(0.0113)
lnhouseholdsize	0.0123	0.00924	0.0111	0.0666***	0.0668***	0.0592***
	(0.00842)	(0.00836)	(0.00845)	(0.00607)	(0.00607)	(0.00669)
Children	0.000942	0.000413	-0.000801	-0.00617*	-0.00617*	-0.00607*
	(0.00431)	(0.00427)	(0.00431)	(0.00367)	(0.00368)	(0.00366)
Elderly	-0.000391	-0.00261	-0.00394	-0.000877	-0.000969	0.000196
	(0.00827)	(0.00819)	(0.00828)	(0.00537)	(0.00538)	(0.00537)
Married	-8.94e-05	0.000420	-0.00255	0.0171	0.0162	0.0164
	(0.0163)	(0.0161)	(0.0163)	(0.0126)	(0.0126)	(0.0125)
Divorced	-0.0446	-0.0501	-0.0518	0.0362*	0.0361*	0.0340*
	(0.0381)	(0.0378)	(0.0382)	(0.0198)	(0.0198)	(0.0197)
Widowed	0.00645	0.0143	0.00921	0.0335*	0.0329*	0.0310*
	(0.0254)	(0.0252)	(0.0255)	(0.0176)	(0.0177)	(0.0176)
Primary	0.00860	0.0112	0.0108	0.0140*	0.0140*	0.0139*
	(0.00820)	(0.00813)	(0.00822)	(0.00749)	(0.00749)	(0.00746)
Secondary	0.000258	0.00357	0.00493	0.0125**	0.0129**	0.0132**
	(0.0106)	(0.0105)	(0.0106)	(0.00636)	(0.00636)	(0.00633)
Post-secondary	0.0593	0.0570	0.0627	0.00749	0.00834	0.0136
	(0.0503)	(0.0499)	(0.0505)	(0.0197)	(0.0197)	(0.0197)
University	0.0196	0.0174	0.0199	0.0464***	0.0469***	0.0446***
	(0.0136)	(0.0134)	(0.0136)	(0.0101)	(0.0101)	(0.0101)
Wage employed	-0.0128*	-0.0145**	-0.0111*	-0.0135**	-0.0134**	-0.0126**
	(0.00665)	(0.00660)	(0.00667)	(0.00540)	(0.00542)	(0.00537)
Wealth	0.00837***	0.00775***	0.00816***	0.00148	0.00116	0.00106
	(0.00235)	(0.00233)	(0.00236)	(0.00185)	(0.00182)	(0.00178)
Constant	0.356***	0.355***	0.336***	0.155***	0.151**	0.169***
	(0.0560)	(0.0555)	(0.0562)	(0.0598)	(0.0599)	(0.0598)
Observations	922	922	922	840	840	840
R-squared	0.116	0.131	0.111	0.176	0.175	0.182

In summary, the results reported in Tables 7.8 and 7.9 confirm the negative impact of CHE on the urban households' livelihood in the five states under consideration. This result also lends support to other studies that document the association between CHE, deteriorated livelihoods, and poverty (WHO, 2000; VanDamme et al., 2004; Baeza and Packed, 2006; Van Doorslaer et al., 2006, and Xu et al. 2007).

8. Conclusion and Policy Implications

The key aim of this study is to identify the determinants of OOPHE and CHE incurred by urban households in five selected Sudanese states—Red Sea, Kassala, Gadarif, Sinnar, and South Darfur. The study also investigates the impact of CHE on the urban household's livelihood. To make these objectives achievable, the study applies OLS and probit regressions to household data sourced from two editions of the National Baseline Household Survey (NBHS) conducted by Sudan's Central Bureau of Statistics in 2009 and 2014. The analysis leads to results that to a large extent agree with previous studies. However, some estimates display different outcomes. For instance, based on the 2009 NBHS, health insurance membership, income, gender of household head, age of household head, the presence of the under five-children, wage employment, wealth, marital or divorce status of the household head, and distance play no role in deciding the proportion of OOPHE incurred by urban households in these five states. In contrast, factors such as household size, the presence of above 65 among household members, and the presence of household head attending secondary or tertiary school correspond to increased OOPHE.

The analysis based on the 2009 NBHS data shows that health insurance membership corresponds to lower levels of OOPHE incurred by urban household in South Darfur state. The results also show that male-led households in Gadarif and South Darfur states spent significantly less than their female-led households on OOPHE during this time period. In contrast, in the Red Sea state, male-led households spent less on OOPHE compared to female-led ones. The analysis finds that households in Kassala and South Darfur where the head has attended university tend to spend more on OOPHE. Furthermore, increases in distance heighten the level of OOPHE incurred by urban households in Red Sea state and decrease it in Kassala state. The presence of under-five and above 65 members in the household is found to increase OOPHE in South Darfur state. Similarly, the presence of under-five member heightens OOPHE in the Red Sea.

The analysis of the total urban sample based on the 2014 NBHS shows that a household's health insurance status and income are correlated with the levels of OOPHE a household incurs. Specifically, OOPHE is positively correlated with income and negatively correlated with health insurance membership. Different from the analysis based on the 2009 NBHS, the results obtained based on the 2014 NBHS shows that both gender and age of the household head have a significant impact on the magnitudes of OOPHE. Moreover, the results suggest that household size, the educational level of the household head, and the presence of under-five and above 65 members are found to have no role in driving OOPHE. Quite differently, the results based on the 2014 NBHS show that wage employment significantly lowers OOPHE.

The findings based on the 2014 NBHS disaggregated by the state show that health insurance membership, income, the presence of under-five and above 65 members, holding wage job, and marital status correspond to the levels of OOPHE incurred by urban households. Different from the

analysis of the 2009 NBHS disaggregated data, the analysis based on 2014 NBHS reveals that educational attainment may play an important role in deciding OOPHE levels. For instance, heads of household that have attended primary or secondary school are less likely to incur high levels of OOPHE in Gadarif state, although they are more likely to incur OOPHE in Sinnar state. In Red Sea state, OOPHE is negatively related to whether the head of household has engaged in post-secondary schooling. In contrast, being a household head attending university corresponds with increased levels of OOPHE in both Kassala and Sinnar states. Somewhat different from the analysis based on the 2009 disaggregated data, the analysis based on the 2014 disaggregated data suggests that having more wealth corresponds to incurring a lower level of OOPHE in Kassala state.

To give more insight to the analysis, we also examined the data disaggregated by gender. The results show that OOPHE paid by female-led households is positively correlated with wealth, income, and whether the head of household is divorced, while it is negatively related to the head of household's educational attainment. On the other hand, OOPHE incurred by male-led households is positively correlated with income, household size, wealth, the presence of above 65 members, the head of household's educational level, and marriage or divorce status, but inversely related to whether household head has wage employment and the distance to the nearest healthcare facilities.

The analysis targeting the determinants of CHE shows mixed outcomes. For instance, the analysis based on the 2009 NBHS data shows that health insurance coverage has no significant influence on the likelihood of undertaking CHE. In contrast, the analysis based on the 2014 NBHS shows that health insurance membership has a significant influence on the likelihood of incurring CHE. Specifically, the findings show that health insurance membership corresponds to a lower likelihood of incurring CHE at a 10% threshold, but corresponds to a higher likelihood of incurring CHE at a 30% threshold. Moreover, the analysis based on the 2009 data shows that the likelihood of experiencing CHE is significantly affected by factors such as household's income, the age of household head, and the presence of above 65 among household members.

The analysis based on the 2014 NBHS indicates that the likelihood of incurring CHE is significantly driven by factors such as household size, the family's wealth, the distance to the nearest healthcare facilities, and whether the head of household attended secondary or post-secondary school, holds wage employment, and head marital status.

Using the 2009 NBHS data, the regression analysis demonstrates that CHE significantly worsens urban households' livelihood by diminishing its ability to make both food and non-food purchases. However, the analysis based on the 2014 NBHS confirms that CHE imposes a negative effect on the livelihood of the urban household only when it reaches 30% threshold.

Based on these findings, the study proposes a few recommendations to lighten the hardship of healthcare expenditures encountered by urban households in the states under consideration:

1. First, policymakers should expand health insurance membership to include all urban households.

2. Second, according to a report released by the National Health Insurance Fund, approximately 51% of the total population in Sudan is insured. One might assume that this high percentage would lower OOPHE. However, as examined in this study, a positive association between OOPHE and a household's income may signify that health insurance is still far from providing households with comprehensive financial protection. Put differently, the positive association between income and OOPHE implies that a significant proportion of an urban households' income is diverted to cover healthcare spending, and this spending is likely to occur at the expense of other purchases of food and non-food items. To avoid such negative consequences, not only membership in health insurance, but also the actual coverage provided by health insurance programs, needs to be expanded.

3. Third, the findings show that educational attainment may also play a role in lowering OOPHE. Policymakers should take actions to lower school drop-out rates among urban populations, since doing so may also lead to better health outcomes among the population.

4. Fourth, the results show that OOPHE is higher among divorced, widowed and married headed households. Accordingly, policymakers should devise appropriate plans to accommodate these vulnerable groups under the umbrella of health insurance. This could help mitigates skyrocketing OOPHE as well as the prevalence of chronic poverty among such households.

5. Fifth, due to the fact that some states (such as Kassala, Gadarif and South Darfur) are exposed to a continuous influx of domestic and foreign immigrants, policymakers who work on urban planning should take these demographic changes into consideration. In particular, planners should develop enhanced healthcare facilities that can meet the unique needs of immigrant households. Taking such step would contribute greatly to reducing the catastrophic outcomes of private healthcare spending.

6. Sixth, the findings also show that larger households are more likely to incur CHE. With this in mind, policymakers should consider launching a family planning programs to sustain appropriate family sizes among urban communities.

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Appendixes

Appendix 1. Descriptive statistics of variables, based on the 2009NBHS

Variable	Definition	Mean	Std. Dev	Min	Max
Insurance	Dummy variable (1= insured, 0= otherwise)	0.4240506	0.4944589	0	1
Income	Total household income in SDG	689.328	1703.704	0	46000
Healthcare expenditure	Health expenditures, in SDG	62.71113	200.5088	0	5228.75
Food expenditure	Food expenditures, in SDG	671.4174	414.3308	50.31	3687.656
Non- food expenditure	Non-food expenditures, in SDG	411.167	390.1222	23.657	5415.25
Gender	Gender of the head of household (1 = male; 0 = female)	0.9251055	0.26336	0	1
Age	Age of head of household in years	46.34177	13.15151	15	91
Primary	Primary school, dummy	0.2447257	0.4301514	0	1
Secondary	Secondary school, dummy	0.1318565	0.3385133	0	1
Post-secondary	Post-secondary, dummy	0.0042194	0.064854	0	1
University	University, dummy	0.0759494	0.2650569	0	1
Wage employed	Dummy variable (1= wage employment, 0= otherwise)	0.5147679	0.5000457	0	1
Household size	Number of household‘ members	5.863924	2.556117	1	21
No. > 65 years	Number of household’s members more than65 years	0.2078059	0.4619209	0	3
No. < 5 years	Number of household’s members less than 5 years	0.7816456	0.9016005	0	5
Number of Rooms	Number of Rooms	3.425847	1.604213	1	11
Married	Dummy, (1= married; 0= unmarried)	0.8744726	0.3314909	0	1
Divorced	Dummy, (1= divorced; 0= unmarried)	0.0105485	0.1022168	0	1
Widowed	Dummy, (1= widowed; 0= unmarried)	0.0601266	0.2378467	0	1
Distance	Distance in minutes	2.970877	0.8974725	0	4.78
Red Sea	Dummy variable (1= Red Sea, 0= otherwise)	0.164557	0.3709759	0	1
Kassala	Dummy variable (1= Kassala, 0= otherwise)	0.1518987	0.3591122	0	1
Gadarif	Dummy variable (1= Gadarif, 0= otherwise)	0.4050633	0.4911634	0	1
Sinnar	Dummy variable (1= Sinnar, 0= otherwise)	0.1265823	0.33268	0	1
South Darfur	Dummy variable (1= South Darfur, 0= otherwise)	0.1518987	0.3591122	0	1

Appendix 2. Descriptive statistics of the variables, based on the 2014 NBHS

Variable	Definition	Mean	Std. Dev	Min	Max
Insurance	Dummy variable (1= insured, 0= otherwise)	0.5060241	0.5002377	0	1
Income	Total household income in SDG	2225.77	993.7307	367.0195	7630.075
Health expenditure	Health expenditures in SDG	364.1565	717.4213	0	11723.95
Food expenditure	Food expenditures in SDG	1829.329	856.8761	363.6977	9960.079
Non- food expenditure	Non-food expenditures in SDG	963.5446	644.394	87.79446	8648.51
Gender	Gender of the head of household (1 = male; 0 = female)	0.8740416	0.3319843	0	1
Age	Age of head of household in years	46.95728	13.50947	15	95
Primary	Primary school, dummy	0.1555312	.362609	0	1
Secondary	Secondary school, dummy	0.2749179	0.4467176	0	1
Post-secondary	Post-secondary, dummy	0.0186199	0.1352526	0	1
University	University, dummy	0.0766703	0.2662135	0	1
Wage employed	Dummy variable (1= wage employment, 0= otherwise)	0.625	0.4844113	0	1
Household size	Number of household'members	5.802848	2.508869	1	17
No. > 65 years	Number of household's members more than 65 years	0.2771084	0.547013	0	3
No. < 5 years	Number of household's members less than 5 years	0.558598	0.7954882	0	7
Number of Rooms	Number of Rooms	2.516977	1.51816	-9	11
Married	Dummy, (1 = married; 0 = unmarried)	0.8400876	0.3667257	0	1
Divorced	Dummy, (1 = divorced; 0= unmarried)	0.0383352	0.1921093	0	1
Widowed	Dummy, (1 = widowed; 0= unmarried)	0.0668127	0.2498342	0	1
Distance	Distance in minutes	25.06024	15.93792	0	105
Red Sea	Dummy variable (1 = Red Sea, 0 = otherwise)	0.3504929	0.4773858	0	1
Kassala	Dummy variable (1 = Kassala, 0 = otherwise)	.1785323	0.3831701	0	1
Gadarif	Dummy variable (1 = Gadarif, 0 = otherwise)	.1610077	0.3677395	0	1
Sinnar	Dummy variable (1 = Sinnar, 0 = otherwise)	.1500548	0.3573208	0	1
South Darfur	Dummy variable (1 = South Darfur, 0 = otherwise)	0.1599124	0.3667257	0	1

This study investigates determinants of out-of-pocket and catastrophic healthcare expenditures (OOPHE and CHE) incurred by urban households in five Sudanese states, namely, Red Sea, Kassala, Gadarif, Sinnar, and South Darfur. The study also examines the impact of CHE on the livelihoods of households in these states. To achieve these aims, the study applies ordinary least squares (OLS) and probit regression methods to data sourced from Sudanese National Baseline Household Surveys (NBHSs) conducted in 2009 and 2014.

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