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Households Out-of-Pocket Healthcare Expenditures Based on Number of Chronic Conditions in Riyadh, Saudi Arabia: A Quantile Regression Approach

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Keywords: Out-of-Pocket, Chronic Conditions, Quantile Regression, household, Health Sector Transformation

ABSTRACT

Objectives This study investigated the level and associated factors, focusing on the number of individuals with chronic conditions, of out-of-pocket healthcare expenditure (OOPHE).

Design A cross-sectional study design.

Setting Riyadh Province, Saudi Arabia.

Participants A total of 1,176 households used any healthcare services at least once in the past three months.

Outcome measures the OOPHE incurred in the previous three-month period when receiving health services. The effects of predisposing, enabling, and need factors on the level of OOPHE. The association between the number of individuals with chronic conditions in a household and OOPHE along with the OOPHE distribution.

Results The average household OOPHE among all the surveyed households (N=1,176) was SAR 1775.3; for households affected by one chronic condition, households affected by more than one chronic condition were SAR1806 and SAR2704, respectively. If the head of the household was older, better educated, and employed, they were more vulnerable to a higher OOPHE ($p<.0001$). At the household level, the increased number of family members with chronic conditions, the presence of a member less than 14 years old, higher SES status, coverage from health insurance plans, residence in an urban area, and the presence of a member with a disability in the household, were correlated with a considerably greater level of OOPHE. ($p<.0001$). The result of quantile regression analysis indicates that an increase in the number of members with chronic conditions in a household was significantly associated with greater overall OOPHE at higher health expenditure quantiles.

Conclusions The burden of OOPHE on households with chronic conditions remains heavy, and some disparities still exist. A substantial and more prominent role was played by the number of individuals with chronic conditions in a household in increasing the risk of incurring OOPHE.

Strengths and limitations of this study

- The present study was the first in Riyadh, Saudi Arabia, to determine the extent of OOPHE among households and the independently associated factors with OOPHE among households with chronic conditions.

- The results of the present study are essential to reveal the association between the number of members with chronic conditions and the OOPHE distribution.

- The findings have significant implications for designing new policies that would ease the burden of the OOPHE among households with chronic conditions.

- The study's main limitation was that the research did not examine each chronic condition's influence on OOPHE. Future studies must address these gaps and examine how OOPHE is linked to specific chronic diseases

INTRODUCTION

After 2010, Saudi Arabia started raising healthcare spending, [1] with domestic healthcare spending (percentage of Gross Domestic Product [GDP]) going up by nearly 78% over the seven years from 2011 to 2017. The increase was much higher than those in the neighboring countries. [2,3] The Saudi government spent SR167 billion, the third-highest after education and military spending, for health and social affairs, 16.5 percent of the government's overall budget, in 2020. [4]

Chronic diseases are among the greatest threats facing all nations. In Saudi Arabia, findings from the Saudi Health Interview Study have identified a high prevalence of chronic diseases among the Saudi population. [2] Chronic diseases kill more than 83,100 people per year in the Kingdom and are responsible for 73% of all deaths. [5] In addition to causing premature mortality, chronic

diseases also have a negative impact on the economic well-being of individuals, households, and the community at large.

While the Ministry of Health (MoH) is working tirelessly to create a transformed revolutionary healthcare system of better quality, more efficiency, and meet patients' health needs, [6] the enhanced growth of chronic diseases would disrupt the Vision's economic transformation 2030 has set for the country. As the country's population ages and grows, chronic diseases continue to take a huge toll on healthcare systems and society as they usually require various treatments and long-term care, burdening patients, households, and the healthcare system with high economic costs. [7] The projected expense of chronic diseases in Saudi Arabia is currently estimated at USD 18.6 billion a year or 2.8% of GDP. Of that, the USD 5.5 billion from direct healthcare costs was barely scratching the surface of the overall spending on healthcare services. The hidden additional costs were more than twice as high at USD 13.1 billion. [8]

Although the Kingdom has provided universal access to healthcare for the Saudi nationals and expatriates working in the government sector for many decades since its establishment, [6] universal access does not mean that the danger to living standards posed by medical spending is eliminated. In Saudi Arabia, out-of-pocket healthcare expenditure (OOPHEs) constitutes a large proportion of total health expenditure. According to the World Health Organization (WHO), Saudis' OOPHEs accounted for 14.4% of total health expenditure in 2018, and this figure is likely an underestimate of the true OOPHE incurred by those living with chronic conditions. [9] Since patients with chronic diseases are more likely to encounter higher OOPHEs, the spending would be substantial if they suffer from many chronic diseases. [10] In addition, some of the country's public and semi-public health providers do not always meet the patients' demands, which often causes such patients to seek medical care in the private sector and pay more. [11]

The burden of chronic conditions does not just fall on and remain with the chronically ill individual; it also affects the entire household; hence, the entire household becomes an indirect sufferer. Because chronic diseases tend to be lengthy and often require continuous monitoring, there are frequent, unexpected, and additional OOPHEs. The total household's OOPHEs would be even higher with an increasing number of members in the household with chronic conditions. This may lead to difficulties in healthcare access, adversely impacting patients' health. Moreover, high levels of OOPHE have been shown to influence patients' behavior in seeking medical

attention, influence treatment decisions, cause financial distress for patients, reduce adherence to medicine, and cause delayed diagnosis. [10,12,13] Previous studies have shown that households' socio-economic and other characteristics influence the levels of OOPHE. [10,14,15]

The Saudi MoH acknowledges that eliminating or reducing financial obstacles leads to greater accessibility to healthcare. However, there is limited understanding in the literature on the levels of OOPHE among households with chronic conditions in Saudi Arabia. Decision-makers and policymakers must be aware of these conditions' financial burdens on individuals, households, and society and understand its determinants. One study focused on the relationship between income, insurance, and OOPHE. [16] In response to this limitation in the literature, we first determined the extent of OOPHE among households in Riyadh, Saudi Arabia. Second, we aimed to determine the independently associated factors with OOPHE among households with chronic conditions. Finally, we estimated the association between the number of members with chronic conditions and the OOPHE distribution. This information is essential to reveal the extent of this impact and help the government, healthcare sector, and other policymakers in designing new policies to ease the burden of the OOPHE among households with chronic conditions.

MATERIALS AND METHODS

Study design

A cross-sectional study design was used in Riyadh Province from January 2021 to the end of June 2021. The Province of Riyadh is the second-largest region in the area after the Eastern Province with 404,240 km^2 and the second-largest in population after the Region of Mecca with 3,681,927 Saudi households. [17] It comprises urban areas (defined as having at least 5,000 people) and roughly a hundred dispersed villages with fewer than 5,000 inhabitants. Rural regions in the Riyadh Province account for 8.5% of Riyadh's total population. [18] In 2019, the national per capita GDP was SAR86,901. Riyadh was ranked second in per capita GDP among the 13 provinces in Saudi Arabia, with a GDP per capita of SAR121,395. [17]

Study population and sampling methods

The study population comprised households that received care during the three months before the interview. We included any head of the household aged 18 years or older whose households

had used any healthcare services at least once in the past three months. The household headship was self-identified by household members. We excluded newly married couples who had been in a household for less than three months at the interview and households with incomplete data for the dependent or independent variables. Households were excluded if any of the household members were suffering from seasonal cases or hospitalized.

Based on reported numbers by the General Authority for Statistics (GaStat), which gave the prevalence of chronic conditions in Saudi Arabia as 15.9%, [19] at the 95% level of significance, and a margin of error of 5%, we determined the smallest sample size possible to be ≈ 205.47 households. To attain a representative sample of the study population living in Riyadh, we followed the WHO cluster sampling method. [20] Using a study design effect of 1.5 (as recommended by the STEPS survey guideline), [21] the sample size was recalculated to be $205.47 \times 1.5 = 308$. Assuming a 10% non-response rate, the end sample size was determined at 308 x 100/90 = 343 households. We increased the sample size to 1,255 households to better understand the situation.

To select households, the sample size was divided into 60 clusters: 50 from urban and ten from rural areas. The districts were randomly selected from each cluster, and households were sampled in proportion to the area's population. Only one household per apartment complex or building was included to ensure the sample was representative and geographically diverse. A substitute household was used if the home location was remote or inaccessible from a road or if the household refused to participate in the interview.

Data collection

Face-to-face interviews with the heads of selected households were conducted using a standardized questionnaire. To ensure reliability and consistency, interviews were conducted during home visits by teams of well-trained interviewers who had previously been trained in administering the research questionnaire. Each team consisted of two men and one woman. Male household heads were interviewed by male interviewers, while females interviewed female household heads.

Measures and questionnaire

The questionnaire was built to accomplish the study's aims. The Andersen Behavioral Model was used as a guideline to identify variables that may affect the OOPHE level. [22] Although Andersen's suggested concepts were utilized, further literature checks were conducted to confirm their suitability.

The questionnaire consisted of four sections: information on OOPHE, predisposing characteristics, enabling characteristics, and need-based characteristics. Experts carefully checked the content validity of research materials to ensure that the structured questionnaire was suitable and contained the necessary information. A pilot research project was conducted to assess the questionnaire's reliability, and the questionnaire was tested on 30 participants on two occasions, two weeks apart. All the questionnaires that had been completed were reviewed for their internal validity.

The dependent variable

The primary outcome of this study was OOPHE. According to the International Classification for Health Accounts, OOPHE is defined as payments paid at the time of utilizing any healthcare item or service given by any type of provider, both formal and informal, including deductibles, copayments, and coinsurance, and excluding pre-payments made in the form of insurance and any compensation received from a third party. [23]

The respondents were asked to report the OOPHE incurred by the family in the previous three-month period to receive healthcare. We divided the whole OOPHE into three main groups--namely medical services, medicines, and other expenses--to identify what categories are key drivers of increased spending. The interviews did not include questions on inpatient and outpatient use. Other expenses included informal care, hearing aids, therapeutic appliances, and equipment. Spending on nutritional supplements and alternative and/or traditional medicine was also included in OOPHE. All results were divided by three to report the monthly OOPHE at the household level.

Independent variables

To conduct our research, we identified independent variables of interest and re-categorized them into three groups: predisposing, enabling, and need-based characteristics. These variables belong to respondents and their households' characteristics.

Predisposing factors include information related to the household head such as gender, age, marital status (not married or married), living condition, and educational status (illiterate /read/write, school degree, or higher education) and information related to the household, such as the total number of family members and the presence of at least one member less than 14 years old.

Enabling factors include household head employment status (unemployed or employed), residential area (rural or urban), health insurance (yes or no), and having a regular doctor (yes or no). Taking into consideration the high level of unreliability, [24] including the reluctance of individuals to reveal accurate information about their income, [25] researchers consider a valid country-specific socio-economic status index (SES index) as a better economic indicator for the household than income. Our study measured SES status using the continuous Saudi-based SES index, where information from the households' asset holdings was used. [26] The Household SES index was ranked into five quintiles, with the quintile including the poorest households labeled as the first quintile and the quintile containing the wealthiest households labeled as the fifth quintile.

Need-based characteristics include the household head's level of physical activity (active (at least 75 minutes of vigorous activity or at least 150 minutes of moderate or vigorous activity per week), moderately active (1 to 74 minutes of vigorous activity or 1 to 149 minutes of moderate or vigorous activity per week), and inactive (0 minutes of moderate or vigorous activity per week), presence of at least one member with a chronic condition (yes or no), presence of at least one member with a disability (yes or no), and presence of at least one pregnant member (yes or no).

This study included all chronic diseases to reflect the full effect in Saudi Arabia. There is no conventional definition for a chronic condition. However, the broad consensus is that it is characterized as a condition that persists over a lengthy time. Various sources specify different amounts of time for a disease to be chronic, from three months to one year. Any individual using

medicines regularly for the last 30 days was deemed a chronic condition in the current study. The surveyed households were grouped into households not affected by a chronic condition (not-CCA households) when there was no chronically ill member in the household; households affected by one chronic condition (one-CCA households), when there was only one chronically ill member in the household; and households affected by more than one chronic condition (more-than-one-CCA households), when there was more than one chronically ill member in the household.

Ethics, consent, and permissions

This study was subjected to the Ministry of Health institutional review board evaluation and approved (IRB#00010471). The study met ethical standards in agreement with the World Medical Association Declaration of Helsinki. The data anonymization and aggregation were used to ensure the confidentiality of the information. Prior written informed consent was acquired from each respondent before conducting the research.

Statistical analysis

The household's head and characteristics were investigated for their many aspects during the descriptive analysis. To describe the OOPHE data, we utilized mean and standard deviation. Then, to determine the effects of predisposing, enabling, and need factors on OOPHE levels among CCA households, we used a generalized linear regression model (GLM) accounting for the specific characteristics of our data. GLM can effectively handle non-normality and heteroscedasticity data using the Box-Cox transformation.

Quantile multivariate regressions were used to estimate the associations between the number of members with a chronic condition and OOPHE level and the OOPHE distribution at the 10th, 25th, 50th, 75th, and 90th percentiles, controlling for study variables. We applied the same models to estimate the impact on OOPHE's different categories, services, medicines, and other expenses for a given number of members with chronic conditions. The coefficients at lower percentiles represent the relationship of the number of members with chronic conditions with OOPHE in those individuals with low OOPHEs, while upper percentiles reveal the relationship for those with higher OOPHEs. All data were analyzed using SAS version 9.4. For all tests, a *p*-

value of <.05 was considered statistically significant. For all analysis, Saudi Arabian Riyals (SAR) (1 US$ = 3.75 SAR) were used as the currency.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

This survey involved the interview of 1,255 households. After excluding the 79 (6.3% of the total) households that could not provide all of the requested information, we had 1,176 households remaining, for which the overall response rate was 88.2%.

Surveyed households' characteristics

Out of the total 1,176 households, more than three-quarters of households (75.51%) were male-headed households, and the majority of household heads were aged twenty-nine years and younger (27.3%) or between thirty and thirty-nine years (21.17%). The study also revealed that the majority of household heads were married (82.65%), lived together with their families (91.84%), had a school degree (43.62%), and were employed (55.1%), and were physically active (37.76%). Surveyed households' characteristics are shown in Table 1.

Table 1 Surveyed households' characteristics (*n*= 1176)

Characteristics	N	Percentage (%)
Predisposing		
Household head gender		
Female	288	24.49
Male	888	75.51
Household head age group, year		
≤ 29	321	27.3
30 - 39	249	21.17
40 - 49	240	20.41
50 - 59	207	17.6
≥ 60	159	13.52
Household head marital status		
Not married	204	17.35
Married	972	82.65
Household head living condition		
Alone	96	8.16
With family	1080	91.84
Household head educational status		
Illiterate/read/write	174	14.8
School degree	513	43.62
Higher education	489	41.58
Number of family members		

≤ 3	384	32.65
4 - 6	528	44.9
≥ 7	264	22.45
Presence of at least one member less than 14 years		
No	552	46.94
Yes	624	53.06
Nationality		
Saudi	1116	94.90
Non-Saudi	60	5.10
Enabling		
Residential area		
Rural	264	22.45
Urban	912	77.55
Household head employment status		
Unemployed	528	44.9
Employed	648	55.1
SES index		
Q1 (Poorest) (lowest 20%)	156	13.27
Q2 (Poor)	327	27.81
Q3 (Middle)	288	24.49
Q4 (Wealthy)	234	19.9
Q5 (Wealthiest) (higher 20%)	171	14.54
Health Insurance		
No	648	56.84
Yes	492	43.16
Having a regular doctor		
No	624	53.06
Yes	552	46.94
Need-based		
Household head's level of physical activity		
Active	444	37.76
Moderately active	420	35.71
Inactive	312	26.53
Presence of at least one member with a chronic condition		
No	456	38.78
Yes	720	61.22
Number of members with a chronic condition in the households		
Not CCA household	456	38.78
One-CCA household	408	34.69
More than one-CCA household	312	26.53
Presence of at least one member with a disability		
No	864	75.79
Yes	276	24.21
Presence of at least one pregnant member		
No	958	81.51
Yes	218	18.49

Abbreviations: SES: socio-economic status; Not-CCA household: households not affected by a chronic condition; One-CCA household: households affected by one chronic condition; More- than-one-CCA household: households affected by more than one chronic condition.

The Amount of OOPHE of Households

Table 2 illustrates the average monthly OOPHE for households: total OOPHE and OOPHE related to healthcare services, medicines, and other expenses across all households with different

numbers of individuals with chronic conditions. The average total monthly household OOPHE was SAR1,775. This appears to be driven mainly by healthcare services and medicines.

One-CCA households spent a total average of SAR1,806 (SD = SAR297) on their health per month, three times as much as not-CCA households (mean SAR651 SD = SAR454), with the most considerable portion of OOPHE spent on healthcare services. The average monthly OOPHE per more than one-CCA household was even more significant compared to not-CCA households (mean SAR2,704 SD = SAR466), with the most significant share of the OOPHE spent on medicines.

Table 2 Distribution of OOPHE incurred by the household per month, SAR.

OOPHE items	All households		Number of members with chronic conditions					
			Not CCA household		one-CCA household		More than one-CCA household	
	N= 1,176		n= 456		n= 408		n= 312	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Total OOPHE	1,775	897	651	454	1,806	297	2,704	466
Services	653	323	335	265	849	131	861	169
Medicines	621	485	179	202	643	176	1,240	346
Other expenses	321	209	136	88	313	72	602	136

Abbreviations: OOPHE: out-of-pocket healthcare expenditure, SES: socio-economic status; Not-CCA households: households not affected by a chronic condition; One-CCA household: households affected by one chronic condition; More-than-one-CCA household: households affected by more than one chronic condition.

Determinants of OOPHE among all CCA households

According to GLM findings (Table 3), regardless of the number of chronically ill household members, household head characteristics impact OOPHE. An older, better educated, employed household head had a positive coefficient (p<.0001). At the household level, the number of family members, the number of members with chronic diseases, the presence of a member under 14 years old, non-Saudi, urban residence, and a person with a disability were positively linked with OOPHE (p<.0001).

The findings also show that the amount of OOPHE increased significantly with the household SES increase. For example, the wealthiest (higher 20%) households tend to spend more on OOPHE compared with the poorest (coefficient=0.154, *p*<.0001). Households covered by health insurance plans are remarkably associated with higher OOPHE than those without health

insurance ($p<.0001$). Finally, having a regular doctor has a negative effect on the level of OOPHE ($p<.0001$).

Table 3 The effects of predisposing, enabling, and need factors on OOPHE level among CCA households: Generalized linear model (Box-Cox Transformation)

Independent variable	Coefficients	Standard Error	*P*-value
Household head gender (reference category: Female)			
Male	0.015	0.027	0.5
Household head age group, year (reference category: ≤ 29)			
30 - 39	-0.002	0.041	0.9
40 - 49	0.084	0.039	0.03
50 - 59	0.079	0.036	0.02
≥ 60	0.225	0.037	<.0001
Household head marital Status (reference category: Not married)			
Married	0.023	0.042	0.7
Household head living condition (reference category: Alone)			
With Family	0.053	0.077	0.1
Household head educational status (reference category: Illiterate /read/write)			
School degree	0.124	0.035	0.0005
Higher education	0.157	0.041	0.0001
Number of family members (reference category: ≤ 3)			
4 - 6	0.177	0.043	<.0001
≥ 7	0.181	0.045	<.0001
At least one member less than 14 years (reference category: No)			
Yes	0.131	0.026	<.0001
Nationality (reference category: Saudi)			
Not Saudi	0.251	0.073	0.0007
Residential area (reference category: Rural)			
Urban	0.245	0.025	<.0001
Household head employment status (reference category: Unemployed)			
Employed	0.133	0.033	<.0001
SES index (reference category: Q1 (Poorest) (lowest 20%)			
Q2 (Poor)	0.011	0.023	0.9
Q3 (Middle)	0.081	0.028	0.1
Q4 (Wealthy)	0.079	0.036	0.02
Q5 (Wealthiest) (higher 20%)	0.154	0.039	<.0001
Health Insurance (reference category: No)			
Yes	0.112	0.026	<.0001
Having a regular doctor (reference category: No)			
Yes	-0.151	0.039	<.0001
Household head's level of physical activity (reference category: Active)			
Moderately active	0.001	0.032	0.9
Inactive	0.029	0.036	0.07
At least one member with a disability (reference category: No)			
Yes	0.292	0.028	<.0001
At least one pregnant member (reference category: No)			
Yes	0.004	0.027	0.8

Abbreviations: SES: socio-economic status; Not-CCA household: households not affected by chronic conditions; One-CCA household: households affected by one chronic condition; More-than-one-CCA household: households affected by more than one chronic condition-.
Results are controlled for study variables.

The OOPHE distribution of households with varying numbers of chronic conditions was explored. Quantile regression findings are in Table 4. Estimated coefficients and p-values are divided into five percentiles. According to the data, the number of chronic conditions in a household affects OOPHE and its categories differently as the quantile increases. A household's higher number of chronic conditions was related to higher total OOPHE at the top range of health expenditures. One-CCA households had greater effects on OOPHE than Not-CCA households, shown at the top of the expenditure distribution (coefficients of SAR646 at the 10th percentile and SAR1,209 at the 90th percentile, respectively).

Table 4 Quantile regression results for the number of individuals with chronic conditions associated with monthly OOPHE.

OOPHE items	Number of members with chronic conditions	Quantile regression														
		10th percentile			25th percentile			50th percentile			75th percentile			90th percentile		
		β (SAR)	(95% CI)		β (SAR)	(95% CI)		β (SAR)	(95% CI)		β (SAR)	(95% CI)		β (SAR)	(95% CI)	
Overall OOPHE	Not-CCA household [a]															
	One-CCA household	646 *	550	743	689 **	597	781	1261 *	1,219	1,303	1,329 **	1,294	1,363	1,209 **	1,174	1,24
	More than one-CCA household	1,772 **	1600	1,943	1,722 *	1,613	1,831	1,649 ***	1,518	1,779	2,099 **	2,051	2,146	2,072 **	2,027	2,1
Services	Not-CCA household [a]															
	One-CCA household	383**	373	393	261**	253	268	610 ***	606***	614	653 *	639	666	590**	580	59
	More than one-CCA household	406**	387	426	325**	311	338	608*	595	621	516*	459	572	692**	673	71
Medicine	Not-CCA household a															
	One-CCA household	473 **	462	483	470*	464	477	549**	543	555	369 *	322	417	259 ***	156	36
	More than one-CCA household	785 *	762	807	947 *	933	960	1,141*	1,128	1,154	1,159 **	1,107	1,212	1,260 ***	1,162	1,35
Other expenses	Not-CCA household [a]															
	One-CCA household	221*	218	223	204*	197	210	128	106	150	157	137	176	166**	154	17
	More than one-CCA household	464**	455	472	473**	461	484	471**	418	525	515**	491	538	517***	507	52

[a] Reference
Abbreviations: Not-CCA household: households not affected by a chronic condition; One-CCA household: households affected by one chronic condition; More-than-one-CCA household: households affected by more than one chronic condition-.
*p-value < 0.05 **p-value < 0.01 ***p-value < 0.001.
Coefficients are estimated after adjusting for study variables.

DISCUSSION

OOPHE restricts comprehensive health care and financial support, particularly for people with chronic conditions. In Saudi Arabia, identifying population groups that OOPHE may disproportionately impact is crucial. Thus, we examined OOPHE levels in Riyadh Province, Saudi Arabia. The data showed that CCA households reported much higher OOPHE than households with no members with chronic conditions, which is mirrored in the international

literature. [27,28,29] Looking closely into the compositions of OOPHE, households with more than one member suffering from health conditions have greater OOPHE for services and medicines due to their complex care and treatment needs. Our findings are consistent with those of the earlier studies.[30,31,32] Policymakers may consider moving from a single-disease perspective to one that includes Multimorbidity, especially when allocating financial resources and devising policy strategies.

Additionally, the study examined the relationship between predisposing, enabling, and need variables and the magnitude of OOPHEs among CCA households. Our data indicated that the risk of OOPHE was greater in homes headed by older adults, which is in line with previous results. [29] This increased likelihood is due to the older generation's greater demand for and utilization of healthcare services than younger age groups. Our research also found that a household head with a higher educational level was associated with a higher level of OOPHE, probably due to higher awareness of the importance of health and more knowledge about healthcare alternatives. This conclusion corroborates research performed in other nations. [33,34] Our study also discovered that employment status is a major factor. Our finding indicated that employed heads of households are more likely to have larger OOPHE than those unemployed. This conclusion is consistent with findings from other nations' investigations. [35,36] The research found that the "number of family members" affected OOPHE. Increasing family size increases medical care use and OOPHE. China and Serbia had similar outcomes. [37,38] On the other hand, this finding contradicts Li et al. and Choi et al. [36,39] The number of chronically ill household members is a key predictor of OOPHE. As noted, chronic illness prevalence is linked to higher monthly OOPHE. Our results confirm an earlier study on a similar relationship. [37] A member under 14 is another statistically significant indicator of household healthcare costs. The coefficients show that adding a member under 14 to the household increases OOPHE following prior research. [37,40] Further, the need for care in terms of the presence of a member with a disability in the household increases the risk of experiencing OOPHE. Disabled people have been found to have a greater need for healthcare, as many studies show. [41] Moreover, there is a substantial correlation between a disabled family member's presence and chronic illnesses in most instances. [42] Experiencing higher OOPHE was significantly associated with nationality, and this effect was highest among the non-Saudi nationals, which seemed to contradict an earlier study. [16] This contradiction may be due to the differences in methods and population

characteristics, as we only focused on those who received care three months before the interview. This is an expected finding as over 80% of non-Saudis work in the private sector, [43] which would limit their access to government-run medical facilities. Another unexpected finding was that the level of OOPHE was much greater in urban households than in rural households. This appears counterintuitive and contradictory to what is observed in other countries. [29,44,45] Urban regions may be more likely to have superior medical facilities and specialists, and patients with chronic conditions tend to live in close proximity.

Our data suggest that wealthy families are more likely to spend OOPHE than poor households. It is safe to infer that the lower class has limited access to medical care and tends to avoid doctors owing to budgetary issues. [46] This finding emphasized the vulnerable position of the poor population when seeking health services. Although data from various countries indicates that insured households incur lower OOPHE, [34,47] our results show that households covered with health insurance spend more on OOPHE. A close look at the connection suggests that health insurance is inadequate to control OOPHE. However, denying health insurance based on this perception may be deceptive. Improved access to treatment and greater healthcare use by insured households may explain the high OOPHE. On the other side, it might be due to adverse selection; families make insurance purchase choices based on their estimated risks; thus, those with chronic conditions are more likely to buy the insurance and utilize more healthcare services. Insured households with generous plans face moral hazards from the increased usage of services.[48] Finally, having a regular doctor has a robust detrimental influence on the OOPHE level. Usually, households with a doctor who visits them regularly have better access to preventive services and are more likely to follow the doctor's prescriptions. Consequently, such patients are less likely than others to return for follow-up appointments after an emergency department visit and have lower rates of health and drug complications. [49,50]

The quantile regression analysis results offer supplemental information on how the number of members in a household with chronic conditions influences the household's overall OOPHE. The mean of OOPHE across the number of individuals with chronic conditions in the household indicates an obvious positive increasing pattern along the OOPHE distribution, reflecting that its mean significantly overestimates having an individual with chronic condition expenditure at the lower end of OOPHE distribution and underestimates the difference of medical payments

between different numbers of members with chronic conditions at higher quantiles along the expenditure distribution. The result implies that the number of individuals with chronic conditions in a household imposes weaker effects on OOPHE when the OOPHE is at a small scale, and this effect is increased as the OOPHE becomes larger.

Survey data and methodology have certain limitations. First, the present data was based on a cross-sectional survey with self-reported OOPHE, which may be impacted by recall and reporting bias. Second, untreated chronic problems may impact our outcomes. Third, the research did not examine each chronic condition's influence on OOPHE. Future studies must address these gaps and examine how OOPHE is linked to specific chronic diseases. Fourth, the study sample comprised households receiving care three months before the interview; OOPHE may be overstated relative to the general population.

Despite these limitations, our finding has important Saudi policy implications. As part of the Health Sector Transformation Program, numerous financial reforms have been undertaken in Saudi Arabia. Program for Health Assurance and Purchasing (PHAP) is nationwide single-payer health insurance to assure free and accessible treatment for all citizens and legal residents via newly MOH-corporatized providers and other governmental providers. Before implementation, it must be planned appropriately, and lowering OOPHE should be a priority. Seniors, individuals with disabilities and chronic conditions, and those on social assistance would have lower copayments and subsidized prescriptions. Another reform is a supplementary health insurance (SHI) system that will allow most citizens and residents to add additional benefits. [51] These reforms are expected to reduce OOPHE and provide financial protection against high OOPHE only if policymakers consider the impact of these policies on persons with chronic conditions and their families. However, their effectiveness can be assessed to improve access to healthcare and reduce OOPHE in families. From the clinical practice perspective, OOPHE associated with chronic diseases can be further minimized by adopting the patient-centered medical home (PCMH) model of care. This model is based on the same principles as the Chronic Care Model, with the primary goal of providing patients with organized, proactive, and coordinated care rather than episodic treatments to improve outcomes while lowering management costs. [52,53]

CONCLUSIONS

Our findings indicate that CCA families pay considerably greater OOPHE compared to not-CCA households. The number of individuals with chronic conditions in a home played a substantial and more prominent role, with a more significant and apparent influence on the higher quantile (vs. the lower quantile). The determinants of OOPHE were studied to identify helpful information for decision-making to reduce the OOPHE among households with chronic conditions. These results may give helpful information to policymakers in the implementation of future healthcare transformation program policies.

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Patient consent for publication Not required**.**

Ethics approval This study was subjected to the Ministry of Health institutional review board evaluation and approved (IRB#00010471). In agreement with the World Medical Association Declaration of Helsinki, the study met ethical standards. The data anonymization and aggregation were used to ensure the confidentiality of the information. Prior written informed consent was acquired from each respondent before carrying out the research.

Data availability statement Data are available on reasonable request; additional data from this study could be accessed by contacting the corresponding author ZA via z.almalki@psau.edu.sa.

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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	9
		(*e*) Describe any sensitivity analyses	9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	10
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10
		(b) Indicate number of participants with missing data for each variable of interest	10
Outcome data	15*	Report numbers of outcome events or summary measures	11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11

			(*b*) Report category boundaries when continuous variables were categorized	11
			(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses		17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
Discussion				
Key results		18	Summarise key results with reference to study objectives	14
Limitations		19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17
Interpretation		20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability		21	Discuss the generalisability (external validity) of the study results	17
Other information				
Funding		22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Investigating Households Out-of-Pocket Healthcare Expenditures Based on Number of Chronic Conditions in Riyadh, Saudi Arabia: A Cross-Sectional Study using Quantile Regression Approach

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ABSTRACT

Objectives This study investigated the level and associated factors, focusing on the Number of individuals with chronic conditions, of out-of-pocket healthcare expenditure (OOPHE).

Design A cross-sectional study was conducted from January 2021 to June 2021.

Setting Riyadh Province, Saudi Arabia.

Participants A total of 1,176 households used any healthcare services at least once in the past three months.

Outcome measures the OOPHE incurred in the previous three-month period when receiving health services. The effects of predisposing, enabling, and need factors on the level of OOPHE. The association between the Number of individuals with chronic conditions in a household and OOPHE along with the OOPHE distribution.

Results The average household OOPHE among all the surveyed households (N=1,176) was SAR 1775.3; for households affected by one chronic condition, households affected by more than one chronic condition were SAR1806 and SAR2704, respectively. If the head of the household was older, better educated, and employed, they were more vulnerable to a higher OOPHE ($p<.0001$). At the household level, the increased Number of family members with chronic conditions, the presence of a member less than 14 years old, higher SES status, coverage from health insurance plans, residence in an urban area, and the presence of a member with a disability in the household, were correlated with a considerably greater level of OOPHE. ($p<.0001$). The result of quantile regression analysis indicates that an increase in the Number of members with chronic conditions in a household was significantly associated with greater overall OOPHE at higher health expenditure quantiles.

Conclusions The burden of OOPHE on households with chronic conditions remains heavy, and some disparities still exist. A substantial and more prominent role was played by the Number of individuals with chronic conditions in a household in increasing the risk of incurring OOPHE.

Strengths and limitations of this study

- The present study was the first in Riyadh, Saudi Arabia, to determine the extent of OOPHE among households and the independently associated factors with OOPHE among households with chronic conditions.

- The results of the present study are essential to reveal the association between the Number of members with chronic conditions and the OOPHE distribution.

- The findings have significant implications for designing new policies that would ease the burden of the OOPHE among households with chronic conditions.

- The study's main limitation was that the research did not examine each chronic condition's influence on OOPHE. Future studies must address these gaps and examine how OOPHE is linked to specific chronic diseases

INTRODUCTION

After 2010, Saudi Arabia started raising healthcare spending [1], with domestic healthcare spending (percentage of Gross Domestic Product [GDP]) going up by nearly 78% over the seven years from 2011 to 2017. The increase was much higher than those in the neighboring countries [2], [3]. The Saudi government spent SR167 billion, the third-highest after education and military spending, for health and social affairs, 16.5 percent of the government's overall budget, in 2020 [4].

Chronic diseases are among the greatest threats facing all nations. In Saudi Arabia, findings from the Saudi Health Interview Study have identified a high prevalence of chronic diseases among the Saudi population [2]. Chronic diseases kill more than 83,100 people per year in the Kingdom and are responsible for 73% of all deaths [5]. In addition to causing premature mortality, chronic

diseases also have a negative impact on the economic well-being of individuals, households, and the community at large.

The primary healthcare providers in Saudi Arabia are the public and the private sector, respectively. The public sector remains the dominant source of healthcare finance. More than 60 percent of Saudi Arabia's health services are provided by the Ministry of Health, which operates 13 health directories. Several other government health sectors serve 17% of their targeted population, often workers and their families, with health care services. They receive their annual budgets directly from the Ministry of Finance through their respective ministries and agencies. However, the private sector provides 23 percent of all health care services, a number that is steadily increasing [6]. The new regulatory reforms have encouraged greater participation of the private sector. Private sector expats and Saudi natives (and their families) must have medical insurance. As more public services are privatized and public-private partnerships are formed, healthcare will shift to the private sector. Current medical insurance companies are designing solutions to address future needs for public sector workers [7].

While the Ministry of Health (MoH) is working tirelessly to create a transformed revolutionary healthcare system of better quality, more efficiency, and meet patients' health needs [7]. the enhanced growth of chronic diseases would disrupt the Vision's economic transformation 2030 has set for the country. As the country's population ages and grows, chronic diseases continue to take a huge toll on healthcare systems and society as they usually require various treatments and long-term care, burdening patients, households, and the healthcare system with high economic costs [8]. The projected expense of chronic diseases in Saudi Arabia is currently estimated at USD 18.6 billion a year or 2.8% of GDP. Of that, the USD 5.5 billion from direct healthcare costs was barely scratching the surface of the overall spending on healthcare services. The hidden additional costs were more than twice as high at USD 13.1 billion [9].

Although the Kingdom has provided universal access to healthcare for the Saudi nationals and expatriates working in the government sector for many decades since its establishment [7], universal access does not mean that the danger to living standards posed by medical spending is eliminated. In Saudi Arabia, out-of-pocket healthcare expenditure (OOPHEs) constitutes a large proportion of total health expenditure. According to the World Health Organization (WHO), Saudis' OOPHEs accounted for 14.4% of total health expenditure in 2018, and this figure is

likely an underestimate of the true OOPHE incurred by those living with chronic conditions [10]. Since patients with chronic diseases are more likely to encounter higher OOPHEs, the spending would be substantial if they suffer from many chronic diseases [11]. In addition, some of the country's public and semi-public health providers do not always meet the patients' demands, which often causes such patients to seek medical care in the private sector and pay more [12].

The burden of chronic conditions does not just fall on and remain with the chronically ill individual; it also affects the entire household; hence, the entire household becomes an indirect sufferer. Because chronic diseases tend to be lengthy and often require continuous monitoring, there are frequent, unexpected, and additional OOPHEs. Several studies suggest that NCDs impact OOP health expenditure in various nations. For example, families with NCD patients in Vietnam were 3.2 and 2.3 times more likely to face catastrophic health costs and poverty, respectively [13] According to a different study, the poorest CVD patients and their families in China, Tanzania, and India are the most impacted by catastrophic health spending [14]. Another research discovered that households with NCDs are statistically more likely than non-NCD households to experience catastrophic costs in low- and middle-income nations [15]. Low-income individuals with cardiovascular disease and stroke had the greatest catastrophic spending rates in Tanzania, India, and China. Cancer patients in Iran, Vietnam, and Nigeria reported the greatest costs [16]. The total household's OOPHEs would be even higher with an increasing number of members in the household with chronic conditions. This may lead to difficulties in healthcare access, adversely impacting patients' health. Moreover, high levels of OOPHE have been shown to influence patients' behavior in seeking medical attention, influence treatment decisions, cause financial distress for patients, reduce adherence to medicine, and cause delayed diagnosis [11], [17], [18] Previous studies have shown that households' socio-economic and other characteristics influence the levels of OOPHE [11], [19], [20]

The Saudi MoH acknowledges that eliminating or reducing financial obstacles leads to greater accessibility to healthcare. However, there is limited understanding in the literature on the levels of OOPHE among households with chronic conditions in Saudi Arabia. Decision-makers and policymakers must be aware of these conditions' financial burdens on individuals, households, and society and understand its determinants. One study focused on the relationship between income, insurance, and OOPHE [21]. In response to this limitation in the literature, we first

determined the extent of OOPHE among households in Riyadh, Saudi Arabia. Second, we aimed to determine the independently associated factors with OOPHE among households with chronic conditions. Finally, we estimated the association between the Number of members with chronic conditions and the OOPHE distribution. This information is essential to reveal the extent of this impact and help the government, healthcare sector, and other policymakers in designing new policies to ease the burden of the OOPHE among households with chronic conditions.

MATERIALS AND METHODS

Study design

A cross-sectional study design was used in Riyadh Province from January 2021 to the end of June 2021. The Province of Riyadh is the second-largest region in the area after the Eastern Province with 404,240 km2 and the second-largest in population after the Region of Mecca with 3,681,927 Saudi households [22]. It comprises urban areas (defined as having at least 5,000 people) and roughly a hundred dispersed villages with fewer than 5,000 inhabitants. Rural regions in the Riyadh Province account for 8.5% of Riyadh's total population [23]. In 2019, the national per capita GDP was SAR86,901. Riyadh was ranked second in per capita GDP among the 13 provinces in Saudi Arabia, with a GDP per capita of SAR121,395 [22].

Study population and sampling methods

The study population comprised households that received care during the three months before the interview. We included any head of the household aged 18 years or older whose households had used any healthcare services at least once in the past three months. The household headship was self-identified by household members. We excluded newly married couples who had been in a household for less than three months at the interview and households with incomplete data for the dependent or independent variables. Households were excluded if any of the household members were suffering from seasonal cases or hospitalized.

Based on reported numbers by the General Authority for Statistics (GaStat), which gave the prevalence of chronic conditions in Saudi Arabia as 15.9% [24], at the 95% level of significance, and a margin of error of 5%, we determined the smallest sample size possible to be ≈ 205.47 households. To attain a representative sample of the study population living in Riyadh, we

followed the WHO cluster sampling method [25]. Using a study design effect of 1.5 (as recommended by the STEPS survey guideline) [26], the sample size was recalculated to be $205.47 \times 1.5 = 308$. Assuming a 10% non-response rate, the end sample size was determined at 308 x 100/90 = 343 households. We increased the sample size to 1,255 households to better understand the situation.

To select households, the sample size was divided into 60 clusters: 50 from urban and ten from rural areas. The districts were randomly selected from each cluster, and households were sampled in proportion to the area's population. Only one household per apartment complex or building was included to ensure the sample was representative and geographically diverse. A substitute household was used if the home location was remote or inaccessible from a road or if the household refused to participate in the interview.

Data collection

Face-to-face interviews with the heads of selected households were conducted using a standardized questionnaire. To ensure reliability and consistency, interviews were conducted during home visits by teams of well-trained interviewers who had previously been trained in administering the research questionnaire. Each team consisted of two men and one woman. Male household heads were interviewed by male interviewers, while females interviewed female household heads.

Measures and questionnaire

The questionnaire was built to accomplish the study's aims. The Andersen Behavioral Model was used as a guideline to identify variables that may affect the OOPHE level [27]. Although Andersen's suggested concepts were utilized, further literature checks were conducted to confirm their suitability.

The questionnaire consisted of four sections: information on OOPHE, predisposing characteristics, enabling characteristics, and need-based characteristics. Experts carefully checked the content validity of research materials to ensure that the structured questionnaire was suitable and contained the necessary information. A pilot research project was conducted to assess the questionnaire's reliability, and the questionnaire was tested on 30 participants on two

occasions, two weeks apart. All the questionnaires that had been completed were reviewed for their internal validity (See supplementary file 1).

The dependent variable

The primary outcome of this study was OOPHE. According to the International Classification for Health Accounts, OOPHE is defined as payments paid at the time of utilizing any healthcare item or service given by any type of provider, both formal and informal, including deductibles, copayments, and coinsurance, and excluding pre-payments made in the form of insurance and any compensation received from a third party [28].

The questionnaire included a section for reporting direct medical OOPHE. We did request estimated spending on several components of OOPHE to verify the overall OOPHE incurred by the family in the previous three-month period to receive healthcare. We utilized a three-month timeframe to minimize the likelihood of recall bias and assure the accuracy of the data given, as it has been shown that reporting error rises as the timeframe of the recall time extends [29]. To determine which categories are important drivers of increased spending, we specify the following components: medical services, which include doctor consultations, physiotherapy, diagnostic tests such as X-rays, ECG, pathology testing, etc., hospital admission charges, medicines, and other expenses; medicines, and other expenses. The interviews did not include questions on inpatient and outpatient use. Other expenses included informal care, hearing aids, therapeutic appliances, and equipment. Spending on nutritional supplements and alternative and/or traditional medicine was also included in OOPHE. All results were divided by three to report the monthly OOPHE at the household level.

Independent variables

To conduct our research, we identified independent variables of interest and re-categorized them into three groups: predisposing, enabling, and need-based characteristics. These variables belong to respondents and their households' characteristics.

Predisposing factors include information related to the household head such as gender, age, marital status (not married or married), and educational status (illiterate /read/write, school degree, or higher education) and information related to the household, such as the total Number

of family members and the presence of at least one member less than 14 years old. According to previous studies, those who live alone are more likely to have health problems and spend more money on health care than those who live in a household with others [30], [31], [32], [33], [34]. It is unknown if those living alone in Saudi Arabia experience an increased burden. Thus, we collected information on the household living condition (alone/not alone).

Enabling factors include household head employment status (unemployed or employed), residential area (rural or urban), health insurance (yes or no), and having a regular doctor (yes or no). Taking into consideration the high level of unreliability [35], including the reluctance of individuals to reveal accurate information about their income [36], researchers consider a valid country-specific socio-economic status index (SES index) as a better economic indicator for the household than income. Our study measured SES status using the Principal Component Analysis (PCA), where information from the households' asset holdings was used as a proxy for the SES of the household [37]. For each interview, an SES index was created based on education level, household head employment status, type of housing, housing tenure, car ownership, and ownership of household assets. We classified the type of housing as a traditional home, a villa, a floor in a villa, an apartment, and other forms of housing. Furthermore, housing tenure was divided into four categories: house owned, home leased, the home provided, and other forms of tenure. Data on car ownership was divided into three categories: no car, one car, and two or more cars. We examined asset ownership using eight dichotomous variables (yes/no): phone available, television available, personal computer available, internet access, library available, satellite available, video available, and video games available. The Household SES index was ranked into five quintiles, with the quintile including the poorest households labeled as the first quintile and the quintile containing the wealthiest households labeled as the fifth quintile.

Need-based characteristics include the household head's level of physical activity classifid according to WHO guidelines [38], (active (at least 75 minutes of vigorous activity or at least 150 minutes of moderate or vigorous activity per week), moderately active (1 to 74 minutes of vigorous activity or 1 to 149 minutes of moderate or vigorous activity per week), and inactive (0 minutes of moderate or vigorous activity per week), presence of at least one member with a chronic condition (yes or no), information on the presence of at least one person with a disability condition, such as physical disability, mental disability, blindness, deafness/muteness, or the

other types of disability that interfere with their usual work or lifestyle, is asked (yes or no), and presence of at least one pregnant member (yes or no).

This study included all chronic diseases to reflect the full effect in Saudi Arabia. There is no conventional definition of a chronic condition. However, the broad consensus is that it is characterized as a condition that persists over a lengthy time. Various sources specify different amounts of time for a disease to be chronic, from three months to one year. Any individual using medicines regularly for the last 30 days was deemed a chronic condition in the current study. Participants in the study were asked whether they had been diagnosed with any of the following chronic diseases: cancer, hypertension, dyslipidemia, diabetes mellitus, congestive heart failure, kidney disease, thyroid disease, pneumonia, psychiatric disease, anemia, or other chronic illnesses. Since we researched to determine the impact of the Number of members with chronic illnesses on OOPHE, we did not request specific information about the disorders. The surveyed households were grouped into households not affected by a chronic condition (not-CCA households) when there was no chronically ill member in the household; households affected by one chronic condition (one-CCA households), when there was only one chronically ill member in the household; and households affected by more than one chronic condition (more-than-one-CCA households), when there was more than one chronically ill member in the household.

Ethics, consent, and permissions

This study was subjected to the Ministry of Health institutional review board evaluation and approved (IRB#00010471). The study met ethical standards in agreement with the World Medical Association Declaration of Helsinki. The data anonymization and aggregation were used to ensure the confidentiality of the information. Prior written informed consent was acquired from each respondent before conducting the research.

Statistical analysis

The household's head and characteristics were investigated for their many aspects during the descriptive analysis. To describe the OOPHE data, we utilized mean and standard deviation. Then, to determine the effects of predisposing, enabling, and need factors on OOPHE levels among CCA households, we used a generalized linear regression model (GLM) accounting for

the specific characteristics of our data. GLM can effectively handle non-normality and heteroscedasticity data. For the final model specification, standardized specifications testing was conducted. Link functions were selected using Box-Cox tests, and distribution families were selected using modified Park tests. A modified Park test and a Box-Cox regression indicated a gamma distribution with a log link function. Multiple diagnostics were used to assess the fit of the chosen link and family: the Pregibon link test, the Ramsey Regression Equation Specification Error Test (RESET), and the modified Hosmer–Lemeshow goodness-of-fit test. We concluded that a log link function is most appropriate in all cases. The gamma distribution was better than other family distributions in general. We estimated all models with the exact specification, so results are comparable across OOPHE items; total OOPHE, medical services, medicines, and other expenses. Regression models adjusted for sociodemographic and other data characteristics.

Quantile multivariate regressions were used to estimate the associations between the Number of members with a chronic condition and OOPHE level and the OOPHE distribution at the 10th, 25th, 50th, 75th, and 90th percentiles, controlling for study variables. We applied the same models to estimate the impact on OOPHE's different categories, services, medicines, and other expenses for a given number of members with chronic conditions. Quantile regression is similar to ordinary least squares regression that does not assume normality and homoscedasticity of the underlying distribution. Thus, it is appropriate for modeling highly skewed or non-normally distributed outcomes as it allows for the analysis of the complete distribution of the outcome variable, providing a vast landscape of different factors that can affect disease costs. The coefficients at lower percentiles represent the relationship of the Number of members with chronic conditions with OOPHE in those individuals with low OOPHEs, while upper percentiles reveal the relationship for those with higher OOPHEs. The Kruskal-Wallis test was used to test for differences of OOPE among quintiles. All data were analyzed using SAS version 9.4. For all tests, a p-value of $<.05$ was considered statistically significant. For all analysis, Saudi Arabian Riyals (SAR) (1 US$ = 3.75 SAR) were used as the currency.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

This survey involved the interview of 1,255 households. After excluding the 79 (6.3% of the total) households that could not provide all of the requested information, we had 1,176 households remaining, for which the overall response rate was 88.2%.

Surveyed households' characteristics

Out of the total 1,176 households, more than three-quarters of households (75.51%) were male-headed households, and the majority of household heads were aged twenty-nine years and younger (27.3%) or between thirty and thirty-nine years (21.17%). The study also revealed that the majority of household heads were married (82.65%), lived together with their families (91.84%), had a school degree (43.62%), and were employed (55.1%), and were physically active (37.76%). Surveyed households' characteristics are shown in Table 1.

Table 1 Surveyed households' characteristics (*n*= 1176)

Characteristics	N	Percentage (%)
Predisposing		
Household head gender		
Female	288	24.49
Male	888	75.51
Household head age group, year		
≤ 29	321	27.3
30 - 39	249	21.17
40 - 49	240	20.41
50 - 59	207	17.6
≥ 60	159	13.52
Household head marital status		
Not married	204	17.35
Married	972	82.65
Household head living condition		
Alone	96	8.16
With family	1080	91.84
Household head educational status		
Illiterate/read/write	174	14.8
School degree	513	43.62
Higher education	489	41.58
Number of family members		
≤ 3	384	32.65
4 - 6	528	44.9
≥ 7	264	22.45
Presence of at least one member less than 14 years		
No	552	46.94
Yes	624	53.06
Nationality		
Saudi	1116	94.90
Non-Saudi	60	5.10
Enabling		
Residential area		

Rural	264	22.45
Urban	912	77.55
Household head employment status		
Unemployed	528	44.9
Employed	648	55.1
SES index		
Q1 (Poorest) (lowest 20%)	156	13.27
Q2 (Poor)	327	27.81
Q3 (Middle)	288	24.49
Q4 (Wealthy)	234	19.9
Q5 (Wealthiest) (higher 20%)	171	14.54
Health Insurance		
No	648	56.84
Yes	492	43.16
Having a regular doctor		
No	624	53.06
Yes	552	46.94
Need-based		
Household head's level of physical activity		
Active	444	37.76
Moderately active	420	35.71
Inactive	312	26.53
Presence of at least one member with a chronic condition		
No	456	38.78
Yes	720	61.22
Number of members with a chronic condition in the households		
Not CCA household	456	38.78
One-CCA household	408	34.69
More than one-CCA household	312	26.53
Presence of at least one member with a disability		
No	864	75.79
Yes	276	24.21
Presence of at least one pregnant member		
No	958	81.51
Yes	218	18.49

Abbreviations: SES: socio-economic status; Not-CCA household: households not affected by a chronic condition; One-CCA household: households affected by one chronic condition; More- than-one-CCA household: households affected by more than one chronic condition.

The Amount of OOPHE of Households

Table 2 illustrates the average monthly OOPHE for households: total OOPHE and OOPHE related to healthcare services, medicines, and other expenses across all households with different numbers of individuals with chronic conditions. The average total monthly household OOPHE was SAR1,775. This appears to be driven mainly by healthcare services and medicines.

One-CCA households spent a total average of SAR1,806 (SD = SAR297) on their health per month, three times as much as not-CCA households (mean SAR651 SD = SAR454), with the most considerable portion of OOPHE spent on healthcare services. The average monthly OOPHE per more than one-CCA household was even more significant compared to not-CCA

households (mean SAR2,704 SD = SAR466), with the most significant share of the OOPHE spent on medicines.

Table 2 Distribution of OOPHE incurred by the household per month, SAR.

OOPHE items	All households		Number of members with chronic conditions					
			Not CCA household		one-CCA household		More than one-CCA household	
	N= 1,176		n= 456		n= 408		n= 312	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Total OOPHE	1,775	897	651	454	1,806	297	2,704	466
Services	653	323	335	265	849	131	861	169
Medicines	621	485	179	202	643	176	1,240	346
Other expenses	321	209	136	88	313	72	602	136

Abbreviations: OOPHE: out-of-pocket healthcare expenditure, SES: socio-economic status; Not-CCA households: households not affected by a chronic condition; One-CCA household: households affected by one chronic condition; More-than-one-CCA household: households affected by more than one chronic condition.

Determinants of OOPHE among all CCA households

According to GLM findings (Table 3), regardless of the Number of chronically ill household members, household head characteristics impact OOPHE. An older, better educated, employed household head had a positive coefficient (p<.0001). At the household level, the Number of family members, the Number of members with chronic diseases, the presence of a member under 14 years old, non-Saudi, urban residence, and a person with a disability were positively linked with OOPHE (p<.0001).

The findings also show that the amount of OOPHE increased significantly with the household SES increase. For example, the wealthiest (higher 20%) households tend to spend more on OOPHE compared with the poorest (coefficient=0.154, *p*<.0001). Households covered by health insurance plans are remarkably associated with higher OOPHE than those without health insurance (*p*<.0001). Finally, having a regular doctor has a negative effect on the level of OOPHE (*p*<.0001).

Table 3 The effects of predisposing, enabling, and need factors on OOPHE level among CCA households: Generalized linear model (Box-Cox Transformation)

Independent variable	Coefficients	95% confidence interval		P-value
Household head gender (reference category: Female)				
Male	0.015	-0.038	0.068	0.5

Household head age group, year (reference category: ≤ 29)				
30 - 39	-0.002	-0.082	0.078	0.9
40 - 49	0.084	0.007	0.161	0.03
50 - 59	0.079	0.008	0.149	0.02
≥ 60	0.225	0.152	0.297	<.0001
Household head marital Status (reference category: Not married)				
Married	0.023	-0.059	0.105	0.7
Household head living condition (reference category: Alone)				
With Family	0.053	-0.098	0.204	0.1
Household head educational Status (reference category: Illiterate /read/write)				
School degree	0.124	0.055	0.193	0.0005
Higher education	0.157	0.077	0.237	0.0001
Number of family members (reference category: ≤ 3)				
4 - 6	0.177	0.093	0.261	<.0001
≥ 7	0.181	0.093	0.269	<.0001
At least one member less than 14 years (reference category: No)				
Yes	0.131	0.079	0.182	<.0001
Nationality (reference category: Saudi)				
Not Saudi	0.251	0.107	0.394	0.0007
Residential area (reference category: Rural)				
Urban	0.245	0.196	0.294	<.0001
Household head employment status (reference category: Unemployed)				
Employed	0.133	0.068	0.198	<.0001
SES index (reference category: Q1 (Poorest) (lowest 20%)				
Q2 (Poor)	0.011	-0.034	0.056	0.9
Q3 (Middle)	0.081	0.026	0.136	0.01
Q4 (Wealthy)	0.079	0.008	0.149	0.02
Q5 (Wealthiest) (higher 20%)	0.154	0.077	0.231	<.0001
Health Insurance (reference category: No)				
Yes	0.112	0.061	0.163	<.0001
Having a regular doctor (reference category: No)				
Yes	-0.151	-0.227	-0.074	<.0001
Household head's level of physical activity (reference category: Active)				
Moderately active	0.001	-0.061	0.063	0.9
Inactive	0.029	-0.041	0.099	0.07
At least one member with a disability (reference category: No)				
Yes	0.292	0.237	0.347	<.0001
At least one pregnant member (reference category: No)				
Yes	0.004	-0.049	0.057	0.8

Abbreviations: SES: socio-economic status; Not-CCA household: households not affected by chronic conditions; One-CCA household: households affected by one chronic condition; More-than-one-CCA household: households affected by more than one chronic condition-.

Results are controlled for study variables.

The OOPHE distribution of households with varying numbers of chronic conditions was explored. Quantile regression findings are in Table 4. The regression coefficient for the variable "number of members with chronic conditions" is defined as the marginal change in the given quantile of the dependent variable that corresponds to the incremental change in the variable. Estimated coefficients and p-values are divided into five percentiles. According to the data, the Number of chronic conditions in a household affects OOPHE and its categories differently as the

quantile increases. A household's higher Number of chronic conditions was related to higher total OOPHE at the top range of health expenditures. One-CCA households had greater effects on OOPHE than Not-CCA households, shown at the top of the expenditure distribution (coefficients of SAR646 at the 10th percentile and SAR1,209 at the 90th percentile, respectively).

Table 4 Quantile regression results for the Number of individuals with chronic conditions associated with monthly OOPHE.

OOPHE items	Number of members with chronic conditions	Quantile regression														p-value†
		10th percentile			25th percentile			50th percentile			75th percentile			90th percentile			
		β (SAR)	(95% CI)		β (SAR)	(95% CI)		β (SAR)	(95% CI)		β (SAR)	(95% CI)		β (SAR)	(95% CI)		
Overall OOPHE	Not-CCA household [a]																
	One-CCA household	646 *	550	743	689 **	597	781	1261 *	1,219	1,303	1,329 **	1,294	1,363	1,209 **	1,174	1,244	0.007
	More than one-CCA household	1,772 **	1600	1,943	1,722 *	1,613	1,831	1,649 ***	1,518	1,779	2,099 **	2,051	2,146	2,072 **	2,027	2,117	0.003
Services	Not-CCA household [a]																
	One-CCA household	383**	373	393	261**	253	268	610 ***	606***	614	653 *	639	666	590**	580	599	0.0002
	More than one-CCA household	406**	387	426	325**	311	338	608*	595	621	516*	459	572	692**	673	710	0.001
Medicine	Not-CCA household a																
	One-CCA household	473 **	462	483	470*	464	477	549**	543	555	369 *	322	417	259 ***	156	362	
	More than one-CCA household	785 *	762	807	947 *	933	960	1,141*	1,128	1,154	1,159 **	1,107	1,212	1,260 ***	1,162	1,357	
Other expenses	Not-CCA household [a]																
	One-CCA household	221*	218	223	204*	197	210	128	106	150	157	137	176	166**	154	177	
	More than one-CCA household	464**	455	472	473**	461	484	471**	418	525	515**	491	538	517***	507	526	

[a] Reference
Abbreviations: Not-CCA household: households not affected by a chronic condition; One-CCA household: households affected by one chronic condition; More-than-one-CCA household: households affected by more than one chronic condition-.
*p-value < 0.05 **p-value < 0.01 ***p-value < 0.001.
Coefficients are estimated after adjusting for study variables.
†Kruskal-Wallis test for differences across quintiles.

DISCUSSION

OOPHE restricts comprehensive health care and financial support, particularly for people with chronic conditions. In Saudi Arabia, identifying population groups that OOPHE may disproportionately impact is crucial. Thus, we examined OOPHE levels in Riyadh Province, Saudi Arabia. The data showed that CCA households reported much higher OOPHE than households with no members with chronic conditions, which is mirrored in the international literature [39], [40], [41]. Looking closely into the compositions of OOPHE, households with more than one member suffering from health conditions have greater OOPHE for services and medicines due to their complex care and treatment needs. Our findings are consistent with those

of the earlier studies [42], [43], [44]. Policymakers may consider moving from a single-disease perspective to one that includes Multimorbidity, especially when allocating financial resources and devising policy strategies.

Additionally, the study examined the relationship between predisposing, enabling, and need variables and the magnitude of OOPHEs among CCA households. Our data indicated that the risk of OOPHE was greater in homes headed by older adults, which is in line with previous results [41]. This increased likelihood is due to the older generation's greater demand for and utilization of healthcare services than younger age groups. Our research also found that a household head with a higher educational level was associated with a higher level of OOPHE, probably due to higher awareness of the importance of health and more knowledge about healthcare alternatives. This conclusion corroborates research performed in other nations [45], [46]. Our study also discovered that employment status is a major factor. Our finding indicated that employed heads of households are more likely to have larger OOPHE than those unemployed. This conclusion is consistent with findings from other nations' investigations [47], [48]. The research found that the "number of family members" affected OOPHE. Increasing family size increases medical care use and OOPHE. China and Serbia had similar outcomes [49], [50]. On the other hand, this finding contradicts Li et al. and Choi et al. [48], [51]. The Number of chronically ill household members is a key predictor of OOPHE. As noted, chronic illness prevalence is linked to higher monthly OOPHE. Our results confirm an earlier study on a similar relationship [49]. A member under 14 is another statistically significant indicator of household healthcare costs. The coefficients show that adding a member under 14 to the household increases OOPHE following prior research [49], [52]. Further, the need for care in terms of the presence of a member with a disability in the household increases the risk of experiencing OOPHE. Disabled people have been found to have a greater need for healthcare, as many studies show [53]. Moreover, there is a substantial correlation between a disabled family member's presence and chronic illnesses in most instances [54]. Experiencing higher OOPHE was significantly associated with nationality, and this effect was highest among the non-Saudi nationals, which seemed to contradict an earlier study [21]. This contradiction may be due to the differences in methods and population characteristics, as we only focused on those who received care three months before the interview. This is an expected finding as over 80% of non-Saudis work in the private sector [43], which would limit their access to government-run medical

facilities. Another unexpected finding was that the level of OOPHE was much greater in urban households than in rural households. This appears counterintuitive and contradictory to what is observed in other countries [41], [56], [57]. Urban regions may be more likely to have superior medical facilities and specialists, and patients with chronic conditions tend to live in close proximity.

Our data suggest that wealthy families are more likely to spend OOPHE than poor households. It is safe to infer that the lower class has limited access to medical care and tends to avoid doctors owing to budgetary issues [58]. This finding emphasized the vulnerable position of the poor population when seeking health services. Although data from various countries indicates that insured households incur lower OOPHE [46], [59], our results show that households covered with health insurance spend more on OOPHE. A close look at the connection suggests that health insurance is inadequate to control OOPHE. However, denying health insurance based on this perception may be deceptive. Improved access to treatment and greater healthcare use by insured households may explain the high OOPHE. On the other side, it might be due to adverse selection; families make insurance purchase choices based on their estimated risks; thus, those with chronic conditions are more likely to buy the insurance and utilize more healthcare services. Insured households with generous plans face moral hazards from the increased usage of services [60]. Finally, having a regular doctor has a robust detrimental influence on the OOPHE level. Usually, households with a doctor who visits them regularly have better access to preventive services and are more likely to follow the doctor's prescriptions. Consequently, such patients are less likely than others to return for follow-up appointments after an emergency department visit and have lower rates of health and drug complications [61],[62].

The quantile regression analysis results offer supplemental information on how the Number of members in a household with chronic conditions influences the household's overall OOPHE. The mean of OOPHE across the Number of individuals with chronic conditions in the household indicates an obvious positive increasing pattern along the OOPHE distribution, reflecting that its mean significantly overestimates having an individual with chronic condition expenditure at the lower end of OOPHE distribution and underestimates the difference of medical payments between different numbers of members with chronic conditions at higher quantiles along the expenditure distribution. The result implies that the Number of individuals with chronic

conditions in a household imposes weaker effects on OOPHE when the OOPHE is at a small scale, and this effect is increased as the OOPHE becomes larger.

It is essential to analyze the potential financial impact of other expenses, particularly for low-income households. Although our data indicate that families with several CCAs incur much higher costs across the quantiles, other expenses may disproportionately impact low-income families, who are also more likely to experience catastrophic health costs. In other words, low-income families may allocate much of their income to other expenses than higher-income families. Policymakers should ensure that people with chronic diseases from low-income families get the help they are entitled to and carry the financial burden associated with their condition.

Survey data and methodology have certain limitations. First, the present data was based on a cross-sectional survey with self-reported OOPHE, which may be impacted by recall and reporting bias. Second, individuals with untreated chronic diseases were not included in our research. Because untreated chronic diseases tend to develop into other conditions and health issues that impose an additional financial burden, the total OOPHE reported in our research may be underestimated. Third, the research did not examine each chronic condition's influence on OOPHE. Future studies must address these gaps and examine how OOPHE is linked to specific chronic diseases. Fourth, the study sample comprised households receiving care three months before the interview; OOPHE may be overstated relative to the general population.

Despite these limitations, our results have significant implications for Saudi strategy. Saudi Arabia has undertaken several financial reforms as part of its Health Sector Transformation Program. The government has created the Center for National Health Insurance (CNHI), formerly known as the Program for Health Assurance and Purchasing (PHAP), to guarantee that all citizens and legal residents who work in the government sector have access to free, accessible, and high-quality health care. People are eligible only if registered at the Primary Healthcare Center, regardless of socioeconomic Status [63]. The Center receives funding from the Ministry of Finance, which it utilizes to purchase healthcare services from providers via health clusters. Purchased Services are based on a benefits package that is heavily founded on clinical and cost-effectiveness studies to ensure the delivery of appropriate care. The CNHI is currently developing a payment structure to fund health clusters. Before implementation, it must

be planned appropriately, and lowering OOPHE should be a priority. Seniors, individuals with disabilities and chronic conditions, and those on social assistance would have lower copayments and subsidized prescriptions. Another reform is a supplementary health insurance (SHI) system that will allow most citizens and residents to add additional benefits [64]. These reforms are expected to reduce OOPHE and provide financial protection against high OOPHE only if policymakers consider the impact of these policies on persons with chronic conditions and their families. However, their effectiveness can be assessed to improve access to healthcare and reduce OOPHE in families. From the clinical practice perspective, OOPHE associated with chronic diseases can be further minimized by adopting the patient-centered medical home (PCMH) model of care. This model is based on the same principles as the Chronic Care Model, with the primary goal of providing patients with organized, proactive, and coordinated care rather than episodic treatments to improve outcomes while lowering management costs [65], [66].

CONCLUSIONS

Our findings indicate that CCA families pay considerably greater OOPHE compared to not-CCA households. The Number of individuals with chronic conditions in a home played a substantial and more prominent role, with a more significant and apparent influence on the higher quantile (vs. the lower quantile). The determinants of OOPHE were studied to identify helpful information for decision-making to reduce the OOPHE among households with chronic conditions. These results may give helpful information to policymakers in the implementation of future healthcare transformation program policies.

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The questionnaire about the household's out-of-pocket healthcare expenditures

1. Formal Consent was provided:
o Yes
o No

Predisposing factors

2. Household head gender:
o Male
o Female

3. Household head age: [ ]

4. Household head marital status
o Married
o Not married

5. Household head living condition
o Alone
o With family

6. Household size [ ]

7. Household head educational
o Illiterate/read/write
o School degree
o Higher education

8. Presence of at least one member less than 14 years
o Yes

o No

9. Nationality
o Saudi
o Non-Saudi

Enabling factors

10. Household head employment status
- o Employed
- o Unemployed

11. Residential area
- o Urban
- o Rural

12. Having a regular doctor:
- o Yes
- o No

13. Having health insurance:
- o Yes
- o No

14. Households' asset holdings

Type of housing	□ A Traditional Home □ A Villa □ A Floor In A Villa □ An Apartment □ Other Forms Of Housing	Housing tenure	□ House Owned □ Home Leased □ The Home Provided □ Other Forms Of Tenure
Car ownership	□ No Car □ One Car □ Two Or More Cars	Phone available	□ Yes □ No
Television available	□ Yes □ No	Personal computer available	□ Yes □ No
Internet access	□ Yes □ No	Library available	□ Yes □ No
Satellite available	□ Yes □ No	Video available	□ Yes □ No

Video games available	□ Yes □ No		

Need-based factors

15. Household head's level of physical activity
o Active (at least 75 minutes of vigorous activity or at least 150 minutes of moderate or vigorous activity per week)
o Moderately active (1 to 74 minutes of vigorous activity or 1 to 149 minutes of moderate or vigorous activity per week)
o Inactive (0 minutes of moderate or vigorous activity per week)

16. Presence of at least one member with a chronic condition
o Yes
o No

17. Presence of at least one member with a disability:
o Yes
o No

18. Presence of at least one pregnant member:
o Yes
o No

19. The number of members with a chronic condition in the households: [   ]

20. Current chronic condition

Dyslipidemia	□ Yes □ No	Hypertension	□ Yes □ No
Diabetes mellitus	□ Yes □ No	Cancer	□ Yes □ No
Thyroid disease	□ Yes □ No	Asthma	□ Yes □ No
Kidney Disease	□ Yes □ No	Psychiatric disease	□ Yes □ No
Congestive Heart Failure	□ Yes □ No	Anemia	□ Yes □ No
Pneumonia	□ Yes □ No	**OTHER**	

OOPHE Components

23. Monthly out-of-pocket on services:

24. Monthly out-of-pocket on medicine:

26. Monthly out-of-pocket on other expenses:

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	9
		(*e*) Describe any sensitivity analyses	9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	10
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10
		(b) Indicate number of participants with missing data for each variable of interest	10
Outcome data	15*	Report numbers of outcome events or summary measures	11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11

		(*b*) Report category boundaries when continuous variables were categorized	11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12

Discussion

Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	17

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Investigating Households' Out-of-Pocket Healthcare Expenditures Based on Number of Chronic Conditions in Riyadh, Saudi Arabia: A Cross-Sectional Study Using Quantile Regression Approach

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Investigating Households' Out-of-Pocket Healthcare Expenditures Based on Number of Chronic Conditions in Riyadh, Saudi Arabia: A Cross-Sectional Study Using Quantile Regression Approach

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ABSTRACT

Objectives This study investigated the level and associated factors, focusing on the number of individuals with chronic conditions, of out-of-pocket healthcare expenditures (OOPHE).

Design A cross-sectional study was conducted from January 2021 to June 2021.

Setting Riyadh Province, Saudi Arabia.

Participants A total of 1,176 households that used any healthcare services at least once in the past three months.

Outcome measures The OOPHE incurred in the previous three-month period when a household member is receiving health services. The effects of predisposing, enabling, and need factors on the level of OOPHE. The association between the number of individuals with chronic conditions in a household and OOPHE along with the OOPHE distribution.

Results The average household OOPHE among all the surveyed households (n=1,176) was SAR 1775.30. For households affected by one chronic condition, OOPHE was SAR1806, and for households affected by more than one chronic condition, OOPHE wasSAR2704. If the head of the household was older, better educated, and employed, they were more vulnerable to a higher OOPHE (p<.0001). At the household level, the increased number of family members with chronic conditions, the presence of a member less than 14 years old, higher SES status, coverage from health insurance plans, residence in an urban area, and the presence of a member with a disability in the household were correlated with a considerably greater level of OOPHE (p<.0001). The result of quantile regression analysis indicates that an increase in the number of members with chronic conditions in a household was significantly associated with greater overall OOPHE at higher health expenditure quantiles.

Conclusions The burden of OOPHE on households with chronic conditions remains heavy, and some disparities still exist. The number of individuals with chronic conditions in a household plays a substantial and prominent role in increasing the risk of incurring OOPHE.

Strengths and limitations of this study

- The questionnaire included questions on estimated OOPHE incurred by the family in the previous three-month period to minimize the likelihood of recall bias and assure the accuracy of the data given.

- To ensure reliability and consistency, interviews were conducted by teams of well-trained interviewers who had previously been trained in administering the research questionnaire.

- The present data were based on a cross-sectional survey with self-reported OOPHE, which may be impacted by recall and reporting bias.

- The research did not examine each chronic condition's influence on OOPHE.

INTRODUCTION

After 2010, Saudi Arabia started raising healthcare spending [1], with domestic healthcare spending (percentage of Gross Domestic Product (GDP)) going up by nearly 78% over the seven years from 2011 to 2017. The increase was much higher in Saudi Arabia than those in neighboring countries [2], [3]. In 2020, the Saudi government spent SR167 billion for health and social affairs, the third-highest amount after allocations for education and military spending, 16.5 percent of the government's overall budget [4].

Chronic diseases are among the greatest threats facing all nations. In Saudi Arabia, findings from the Saudi Health Interview Study have identified a high prevalence of chronic diseases among the Saudi population [2]. Chronic diseases kill more than 83,100 people per year in the Kingdom and are responsible for 73% of all deaths [5]. In addition to causing premature mortality, chronic diseases also have a negative impact on the economic well-being of individuals, households, and the community at large.

The primary healthcare providers in Saudi Arabia are the public and the private sector. The public sector remains the dominant source of healthcare finance. More than 60 percent of Saudi Arabia's

health services are provided by the Ministry of Health, which operates 13 health directories. Several other government health sectors serve 17% of their targeted population, often workers and their families, with healthcare services. They receive their annual budgets directly from the Ministry of Finance through their respective ministries and agencies. However, the private sector provides 23 percent of all healthcare services, a number that is steadily increasing [6]. The new regulatory reforms have encouraged greater participation of the private sector. Private sector expats and Saudi natives (and their families) must have medical insurance. As more public services are privatized and public-private partnerships are formed, healthcare will shift to the private sector. Current medical insurance companies are designing solutions to address future needs for public-sector workers [7].

While the Ministry of Health (MoH) is working tirelessly to create a transformed revolutionary healthcare system of better quality, more efficiency, and to meet patients' health needs [7], the enhanced growth of chronic diseases would disrupt the economic transformation plan that Saudi Vision 2030 has set for the country. As the country's population ages and grows, chronic diseases continue to take a huge toll on healthcare systems and society as they usually require various treatments and long-term care, burdening patients, households, and the healthcare system with high economic costs [8]. The projected expense of chronic diseases in Saudi Arabia is currently estimated at USD 18.6 billion a year or 2.8% of GDP. Of that, the USD 5.5 billion from direct healthcare costs was a fraction of the overall spending on healthcare services. The hidden additional costs were more than twice as high at USD 13.1 billion [9].

Although the Kingdom has provided universal access to healthcare for the Saudi nationals and expatriates working in the government sector for many decades since its establishment [7], universal access does not mean that the danger to living standards posed by medical spending is eliminated. In Saudi Arabia, out-of-pocket healthcare expenditure (OOPHEs) constitutes a large proportion of total health expenditure. According to the World Health Organization (WHO), Saudis' OOPHEs accounted for 14.4% of total health expenditure in 2018, and this figure is likely an underestimate of the true OOPHE incurred by those living with chronic conditions [10]. Since patients with chronic diseases are more likely to encounter higher OOPHEs, the spending would be substantial if they suffer from many chronic diseases [11]. In addition, some of the country's

public and semi-public healthcare providers do not always meet the patients' demands, which often causes such patients to seek medical care in the private sector and to pay more [12].

The burden of chronic conditions does not just fall on and remain with the chronically ill individual. It also affects the entire household; hence, the entire household becomes an indirect sufferer. Because chronic diseases tend to be lengthy and often require continuous monitoring, there are frequent, unexpected, and additional OOPHEs. Several studies suggest that noncommunicable diseases (NCDs) impact OOP health expenditure in various nations. For example, families with NCD patients in Vietnam were 3.2 times more likely to face catastrophic health costs and and 2.3 times more likely to face poverty [13]. According to a different study, the poorest cardiovascular disease (CVD) patients and their families in China, Tanzania, and India are the most impacted by catastrophic health spending [14]. Another study discovered that households with NCDs are statistically more likely than non-NCD households to experience catastrophic costs in low- and middle-income nations [15]. Low-income individuals with cardiovascular disease and stroke had the greatest catastrophic spending rates in Tanzania, India, and China. Cancer patients in Iran, Vietnam, and Nigeria reported the greatest costs [16]. The total household's OOPHEs would be even higher with an increased number of members in the household with chronic conditions. This may lead to difficulties in healthcare access, adversely impacting patients' health. Moreover, high levels of OOPHE have been shown to influence patients' behavior in seeking medical attention, influence treatment decisions, cause financial distress for patients, reduce adherence to medicine, and cause delayed diagnosis [11], [17], [18]. Previous studies have shown that households' socioeconomic status and other characteristics influence the levels of OOPHE [11], [19], [20].

The Saudi MoH acknowledges that eliminating or reducing financial obstacles leads to greater accessibility to healthcare. However, there is limited data in the literature on the levels of OOPHE among households with chronic conditions in Saudi Arabia. Decision-makers and policymakers must be aware of these conditions' financial burdens on individuals, households, and society, and understand its determinants. One study focused on the relationships among income, insurance, and OOPHE [21]. In response to this limitation in the literature, we first determined the extent of OOPHE among households in Riyadh, Saudi Arabia. Second, we aimed to determine the factors independently associated with OOPHE among households with chronic conditions. Finally, we

estimated the association between the number of members with chronic conditions and the OOPHE distribution. This information is essential to reveal the extent of this impact and help the government, healthcare sector, and other policymakers in designing new policies to ease the burden of the OOPHE among households with chronic conditions.

MATERIALS AND METHODS

Study design

A cross-sectional study design was used in Riyadh Province from January 2021 to the end of June 2021. The Province of Riyadh is the second-largest region in area after the Eastern Province, with 404,240 km^2, and the second-largest in population after the Region of Mecca, with 3,681,927 Saudi households [22]. It comprises urban areas (defined as having at least 5,000 people) and roughly a hundred dispersed villages with fewer than 5,000 inhabitants. Rural regions in the Riyadh Province account for 8.5% of Riyadh's total population [23]. In 2019, the national per capita GDP was SAR86,901. Riyadh was ranked second in per capita GDP among the 13 provinces in Saudi Arabia, with a GDP per capita of SAR121,395 [22].

Study population and sampling methods

The study population comprised households that received care during the three months before the interview. We included any head of the household aged 18 years or older whose household had used any healthcare services at least once in the past three months. The household headship was self-identified by household members. We excluded newly married couples who had been in a household for less than three months at the interview and households with incomplete data for the dependent or independent variables. Households were excluded if any of the household members were suffering from seasonal cases or were hospitalized.

Using reported numbers by the General Authority for Statistics (GaStat), which gave the prevalence of chronic conditions in Saudi Arabia as 15.9% [24], at the 95% level of significance, and a margin of error of 5%, we determined the smallest sample size possible to be ≈ 205.47 households. To attain a representative sample of the study population living in Riyadh, we followed the WHO cluster sampling method [25]. Using a study design effect of 1.5 (as recommended by the STEPS survey guideline) [26], we recalculated the sample size to be

$205.47 \times 1.5 = 308$. Assuming a 10% non-response rate, the end sample size was determined to be $308 \times 100/90 = 343$ households. We increased the sample size to 1,255 households to better understand the situation.

To select households, the sample size was divided into 60 clusters: 50 from urban areas and ten from rural areas. The districts were randomly selected from each cluster, and households were sampled in proportion to the area's population. Only one household per apartment complex or building was included to ensure the sample was representative and geographically diverse. A substitute household was used if the home location was remote or inaccessible from a road or if the household refused to participate in the interview.

Data collection

Face-to-face interviews with the heads of selected households were conducted using a standardized questionnaire. To ensure reliability and consistency, interviews were conducted during home visits by teams of well-trained interviewers who had previously been trained in administering the research questionnaire. Each team consisted of two men and one woman. Male household heads were interviewed by male interviewers, while females interviewed female household heads.

Measures and questionnaire

The questionnaire was built to accomplish the study's aims. The Andersen Behavioral Model was used as a guideline to identify variables that may affect the OOPHE level [27]. Although Andersen's suggested concepts were utilized, further literature checks were conducted to confirm their suitability.

The questionnaire consisted of four sections: information on OOPHE, predisposing characteristics, enabling characteristics, and need-based characteristics. Experts carefully checked the content validity of research materials to ensure that the structured questionnaire was suitable and contained the necessary information. A pilot research project was conducted to assess the questionnaire's reliability, and the questionnaire was tested on 30 participants on two occasions, two weeks apart. All the questionnaires that had been completed were reviewed for their internal validity (see supplementary file 1).

The dependent variable

The primary outcome of this study was OOPHE. According to the International Classification for Health Accounts, OOPHE is defined as payments made at the time of utilizing any healthcare item or service given by any type of provider, both formal and informal, including deductibles, copayments, and coinsurance, and excluding pre-payments made in the form of insurance and any compensation received from a third party [28].

The questionnaire included a section for reporting direct medical OOPHE. We did request estimated spending on several components of OOPHE to verify the overall OOPHE incurred by the family in the previous three-month period when receiving healthcare. We utilized a three-month timeframe to minimize the likelihood of recall bias and assure the accuracy of the data given, as it has been shown that reporting error rises as the timeframe of the recall time extends [29]. To determine which categories are important drivers of increased spending, we specify the following components: medical services, which include doctor consultations and physiotherapy; diagnostic tests, such as X-rays, ECG, and pathology testing; hospital admission charges; medicines; and other expenses. The interviews did not include questions on inpatient and outpatient admissions. Other expenses included informal care, hearing aids, therapeutic appliances, and equipment. Spending on nutritional supplements and alternative and/or traditional medicine was also included in OOPHE. All results were divided by three to report the monthly OOPHE at the household level.

Independent variables

To conduct our research, we identified independent variables of interest and recategorized them into three groups: predisposing, enabling, and need-based characteristics. These variables describe to respondents and their households' characteristics.

Predisposing factors include information related to the household head such as gender, age, marital status (not married or married), and educational status (illiterate, /read/write, school degree, or higher education) and information related to the household, such as the total number of family members and the presence of at least one member less than 14 years old. According to previous studies, those who live alone are more likely to have health problems and to spend more money

on healthcare than those who live in a household with others [30], [31], [32], [33], [34]. It is unknown if those living alone in Saudi Arabia experience an increased burden. Thus, we collected information on the household living condition (alone or not alone).

Enabling factors include household head employment status (unemployed or employed), residential area (rural or urban), health insurance (yes or no), and having a regular doctor (yes or no). Taking into consideration the high level of unreliability [35], including the reluctance of individuals to reveal accurate information about their income [36], researchers consider a valid country-specific socioeconomic status index (SES index) as a better economic indicator for the household than income. Our study measured SES status using the Principal Component Analysis (PCA), which uses information from the households' asset holdings as a proxy for the SES of the household [37]. For each interview, an SES index was created using education level, household head employment status, type of housing, housing tenure, car ownership, and ownership of household assets. We classified the type of housing as a traditional home, a villa, a floor in a villa, an apartment, and other forms of housing. Furthermore, housing tenure was divided into four categories: house owned, home leased, the home provided, and other forms of tenure. Data on car ownership was divided into three categories: no car, one car, and two or more cars. We examined asset ownership using eight dichotomous variables (yes/no): phone available, television available, personal computer available, internet access, library available, satellite available, video available, and video games available. The household's SES index was ranked into one of five quintiles, with the quintile including the poorest households labeled as the first quintile and the quintile containing the wealthiest households labeled as the fifth quintile.

Need-based characteristics include the household head's level of physical activity classified according to WHO guidelines [38] (active (at least 75 minutes of vigorous activity or at least 150 minutes of moderate or vigorous activity per week), moderately active (1 to 74 minutes of vigorous activity or 1 to 149 minutes of moderate or vigorous activity per week), or inactive (0 minutes of moderate or vigorous activity per week); presence of at least one member with a chronic condition (yes or no); information on the presence of at least one person with a disability condition, such as physical disability, mental disability, blindness, deafness/muteness, or the other types of disability that interfere with their usual work or lifestyle (yes or no); and presence of at least one pregnant member (yes or no).

This study included all chronic diseases to reflect the full effect of diseases on households in Saudi Arabia. There is no conventional definition of a chronic condition. However, the broad consensus is that it is characterized as a condition that persists over a lengthy time. Various sources specify different amounts of time for a disease to be chronic, from three months to one year. Any individual using medicines regularly for the last 30 days was deemed to have a chronic condition in the current study. Participants in the study were asked whether they had been diagnosed with any of the following chronic diseases: cancer, hypertension, dyslipidemia, diabetes mellitus, congestive heart failure, kidney disease, thyroid disease, pneumonia, psychiatric disease, anemia, or other chronic illnesses. Since our research determined the impact of the number of members with chronic illnesses on OOPHE, we did not request specific information about the disorders. The surveyed households were grouped into three categories: households not affected by a chronic condition (not-CCA households) when there was no chronically ill member in the household; households affected by one chronic condition (one-CCA households) when there was only one chronically ill member in the household; and households affected by more than one chronic condition (more-than-one-CCA households) when there was more than one chronically ill member in the household.

Ethics, consent, and permissions

This study was subjected to the Ministry of Health institutional review board evaluation and approved (IRB#00010471). The study met ethical standards in agreement with the World Medical Association Declaration of Helsinki. The data anonymization and aggregation were used to ensure the confidentiality of the information. Prior written informed consent was acquired from each respondent before conducting the research.

Statistical analysis

The household's head and characteristics were investigated for their many aspects during the descriptive analysis. To describe the OOPHE data, we utilized mean and standard deviation. Then, to determine the effects of predisposing, enabling, and need factors on OOPHE levels among CCA households, we used a generalized linear regression model (GLM) accounting for the specific characteristics of our data. GLM can effectively handle non-normality and heteroscedasticity data. For the final model specification, standardized specifications testing was conducted. Link

functions were selected using Box-Cox tests, and distribution families were selected using modified Park tests. A modified Park test and a Box-Cox regression indicated a gamma distribution with a log link function. Multiple diagnostics were used to assess the fit of the chosen link and family: the Pregibon link test, the Ramsey Regression Equation Specification Error Test (RESET), and the modified Hosmer–Lemeshow goodness-of-fit test. We concluded that a log link function is most appropriate in all cases. The gamma distribution was better than other family distributions in general. We estimated all models with the exact specification, so results are comparable across OOPHE items: total OOPHE, medical services, medicines, and other expenses. Regression models adjusted for sociodemographic and other data characteristics.

Quantile multivariate regressions were used to estimate the associations among the number of members with a chronic condition and OOPHE level and the OOPHE distribution at the 10th, 25th, 50th, 75th, and 90th percentiles, controlling for study variables. We applied the same models to estimate the impact on OOPHE's different categories, services, medicines, and other expenses for a given number of members with chronic conditions. Quantile regression is similar to ordinary least-squares regression that does not assume normality and homoscedasticity of the underlying distribution. Thus, it is appropriate for modeling highly skewed or non-normally distributed outcomes as it allows for the analysis of the complete distribution of the outcome variable, providing a vast landscape of different factors that can affect disease costs. The coefficients at lower percentiles represent the relationship of the number of members with chronic conditions with OOPHE in those individuals with low OOPHEs, while upper percentiles reveal the relationship for those with higher OOPHEs. The Kruskal-Wallis test was used to test for differences of OOPHE among quintiles. All data were analyzed using SAS version 9.4. For all tests, a *p*-value of <.05 was considered statistically significant. For all analysis, Saudi Arabian Riyals (SAR) (US$1 = 3.75 SAR) were used as the currency.

Patient and public involvement Patients and/or the public were not involved in the design, conduct, reporting, or dissemination plans of this research.

RESULTS

This survey involved the interview of 1,255 households. After excluding the 79 (6.3% of the total) households that could not provide all of the requested information, we had 1,176 households remaining, for which the overall response rate was 88.2%.

Surveyed households' characteristics

Out of the total 1,176 households, more than three-quarters of households (75.51%) were male-headed households, and the majority of household heads were aged 29 years and younger (27.3%) or between 30 and 39 years (21.17%). The study also revealed that the majority of household heads were married (82.65%), lived together with their families (91.84%), had a school degree (43.62%), were employed (55.1%), and were physically active (37.76%). Surveyed households' characteristics are shown in Table 1.

Table 1 Surveyed households' characteristics (*n*= 1176)

Characteristics	*N*	Percentage (%)
Predisposing		
Household head gender		
Female	288	24.49
Male	888	75.51
Household head age group, years		
≤ 29	321	27.3
30 - 39	249	21.17
40 - 49	240	20.41
50 - 59	207	17.6
≥ 60	159	13.52
Household head marital status		
Not married	204	17.35
Married	972	82.65
Household head living condition		
Alone	96	8.16
With family	1080	91.84
Household head educational status		
Illiterate/read/write	174	14.8
School degree	513	43.62
Higher education	489	41.58
Number of family members		
≤ 3	384	32.65
4 - 6	528	44.9
≥ 7	264	22.45
Presence of at least one member less than 14 years of age		
No	552	46.94
Yes	624	53.06
Nationality		
Saudi	1116	94.90
Non-Saudi	60	5.10
Enabling		
Residential area		
Rural	264	22.45
Urban	912	77.55
Household head employment status		

Unemployed	528	44.9
Employed	648	55.1
SES index		
Q1 (Poorest) (lowest 20%)	156	13.27
Q2 (Poor)	327	27.81
Q3 (Middle)	288	24.49
Q4 (Wealthy)	234	19.9
Q5 (Wealthiest) (higher 20%)	171	14.54
Health Insurance		
No	648	56.84
Yes	492	43.16
Having a regular doctor		
No	624	53.06
Yes	552	46.94
Need-based		
Household head's level of physical activity		
Active	444	37.76
Moderately active	420	35.71
Inactive	312	26.53
Presence of at least one member with a chronic condition		
No	456	38.78
Yes	720	61.22
Number of members with a chronic condition in the households		
Not CCA household	456	38.78
One-CCA household	408	34.69
More-than-one-CCA household	312	26.53
Presence of at least one member with a disability		
No	864	75.79
Yes	276	24.21
Presence of at least one pregnant member		
No	958	81.51
Yes	218	18.49

Abbreviations: SES: socioeconomic status; Not-CCA household: households not affected by a chronic condition; One-CCA household: households affected by one chronic condition; More-than-one-CCA household: households affected by more than one chronic condition.

The Amount of OOPHE of Households

Table 2 illustrates the average monthly OOPHE for households: total OOPHE and OOPHE related to healthcare services, medicines, and other expenses across all households with different numbers of individuals with chronic conditions. The average total monthly household OOPHE was SAR1,775. This appears to be driven mainly by healthcare services and medicines.

One-CCA households spent a total average of SAR1,806 (SD = SAR297) on their health per month, three times as much as not-CCA households (mean = SAR651, SD = SAR454), with the most considerable portion of OOPHE spent on healthcare services. The average monthly OOPHE per more-than-one-CCA household was even more significant compared to not-CCA

households (mean = SAR2,704, SD = SAR466), with the most significant share of the OOPHE spent on medicines.

Table 2 Distribution of OOPHE incurred by the household per month, SAR.

OOPHE items	All households		Number of members with chronic conditions					
			Not CCA household		one-CCA household		More than one-CCA household	
	N= 1,176		*n*= 456		*n*= 408		*n*= 312	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Total OOPHE	1,775	897	651	454	1,806	297	2,704	466
Services	653	323	335	265	849	131	861	169
Medicines	621	485	179	202	643	176	1,240	346
Other expenses	321	209	136	88	313	72	602	136

Abbreviations: OOPHE: out-of-pocket healthcare expenditure, SES: socioeconomic status; Not-CCA households: households not affected by a chronic condition; One-CCA household: households affected by one chronic condition; More-than-one-CCA household: households affected by more than one chronic condition.

Determinants of OOPHE among all CCA households

According to GLM findings (Table 3), regardless of the number of chronically ill household members, household head characteristics impact OOPHE. An older, better educated, employed household head had a positive coefficient (*p*<.0001). At the household level, the number of family members, the number of members with chronic diseases, the presence of a member under 14 years old, non-Saudi nationality, urban residence, and a person with a disability were positively linked with OOPHE (*p*<.0001).

The findings also show that the amount of OOPHE increased significantly with the household SES increase. For example, the wealthiest (highest 20%) households tend to spend more on OOPHE compared with the poorest (coefficient=0.154, *p*<.0001). Households covered by health insurance plans are remarkably associated with higher OOPHE than those without health insurance (*p*<.0001). Finally, having a regular doctor has a negative effect on the level of OOPHE (*p*<.0001).

Table 3 The effects of predisposing, enabling, and need factors on OOPHE level among CCA households: Generalized linear model (Box-Cox Transformation)

Independent variable	Coefficients	95% confidence interval		P-value
Household head gender (reference category: Female)				
Male	0.015	-0.038	0.068	0.5
Household head age group, year (reference category: ≤ 29)				
30 - 39	-0.002	-0.082	0.078	0.9

40 - 49	0.084	0.007	0.161	0.03
50 - 59	0.079	0.008	0.149	0.02
≥ 60	0.225	0.152	0.297	<.0001
Household head marital status (reference category: Not married)				
Married	0.023	-0.059	0.105	0.7
Household head living condition (reference category: Alone)				
With Family	0.053	-0.098	0.204	0.1
Household head educational status (reference category: Illiterate /read/write)				
School degree	0.124	0.055	0.193	0.0005
Higher education	0.157	0.077	0.237	0.0001
Number of family members (reference category: ≤ 3)				
4 - 6	0.177	0.093	0.261	<.0001
≥ 7	0.181	0.093	0.269	<.0001
At least one member less than 14 years (reference category: No)				
Yes	0.131	0.079	0.182	<.0001
Nationality (reference category: Saudi)				
Not Saudi	0.251	0.107	0.394	0.0007
Residential area (reference category: Rural)				
Urban	0.245	0.196	0.294	<.0001
Household head employment status (reference category: Unemployed)				
Employed	0.133	0.068	0.198	<.0001
SES index (reference category: Q1 (Poorest) (lowest 20%)				
Q2 (Poor)	0.011	-0.034	0.056	0.9
Q3 (Middle)	0.081	0.026	0.136	0.01
Q4 (Wealthy)	0.079	0.008	0.149	0.02
Q5 (Wealthiest) (higher 20%)	0.154	0.077	0.231	<.0001
Health Insurance (reference category: No)				
Yes	0.112	0.061	0.163	<.0001
Having a regular doctor (reference category: No)				
Yes	-0.151	-0.227	-0.074	<.0001
Household head's level of physical activity (reference category: Active)				
Moderately active	0.001	-0.061	0.063	0.9
Inactive	0.029	-0.041	0.099	0.07
At least one member with a disability (reference category: No)				
Yes	0.292	0.237	0.347	<.0001
At least one pregnant member (reference category: No)				
Yes	0.004	-0.049	0.057	0.8

Abbreviations: SES: socioeconomic status; Not-CCA household: households not affected by chronic conditions; One-CCA household: households affected by one chronic condition; More-than-one-CCA household: households affected by more than one chronic condition.

Results are controlled for study variables.

The OOPHE distribution of households with varying numbers of chronic conditions was explored. Quantile regression findings are in Table 4. The regression coefficient for the variable "number of members with chronic conditions" is defined as the marginal change in the given quantile of the dependent variable that corresponds to the incremental change in the variable. Estimated coefficients and *p*-values are divided into five percentiles. According to the data, the number of chronic conditions in a household affects OOPHE and its categories differently as the quantile increases. A household's higher number of chronic conditions was related to higher total OOPHE

at the top range of health expenditures. One-CCA households had greater effects on OOPHE than not-CCA households, shown at the top of the expenditure distribution (coefficients of SAR646 at the 10th percentile and SAR1,209 at the 90th percentile, respectively).

Table 4 Quantile regression results for the number of individuals with chronic conditions associated with monthly OOPHE.

OOPHE items	Number of members with chronic conditions	Quantile regression														*p*-value†
		10th percentile			25th percentile			50th percentile			75th percentile			90th percentile			
		β (SAR)	(95% CI)		β (SAR)	(95% CI)		β (SAR)	(95% CI)		β (SAR)	(95% CI)		β (SAR)	(95% CI)		
Overall OOPHE	Not-CCA household [a]																0.007
	One-CCA household	646 *	550	743	689 **	597	781	1261 *	1,219	1,303	1,329 **	1,294	1,363	1,209 **	1,174	1,244	
	More-than-one-CCA household	1,772 **	1600	1,943	1,722 *	1,613	1,831	1,649 ***	1,518	1,779	2,099 **	2,051	2,146	2,072 **	2,027	2,117	0.0000
Services	Not-CCA household [a]																0.0000
	One-CCA household	383**	373	393	261**	253	268	610 ***	606***	614	653 *	639	666	590**	580	599	
	More-than-one-CCA household	406**	387	426	325**	311	338	608*	595	621	516*	459	572	692**	673	710	0.0000
Medicine	Not-CCA household [a]																0.05
	One-CCA household	473 **	462	483	470*	464	477	549**	543	555	369 *	322	417	259 ***	156	362	
	More-than-one-CCA household	785 *	762	807	947 *	933	960	1,141*	1,128	1,154	1,159 **	1,107	1,212	1,260 ***	1,162	1,357	
Other expenses	Not-CCA household [a]																
	One-CCA household	221*	218	223	204*	197	210	128	106	150	157	137	176	166**	154	177	
	More-than-one-CCA household	464**	455	472	473**	461	484	471**	418	525	515**	491	538	517***	507	526	

[a] Reference

Abbreviations: Not-CCA household: households not affected by a chronic condition; One-CCA household: households affected by one chronic condition; More-than-one-CCA household: households affected by more than one chronic condition-.

*p-value < 0.05 **p-value < 0.01 ***p-value < 0.001.

Coefficients are estimated after adjusting for study variables.

†Kruskal-Wallis test for differences across quintiles.

DISCUSSION

OOPHE restricts comprehensive healthcare and financial support, particularly for people with chronic conditions. In Saudi Arabia, identifying population groups that OOPHE may disproportionately impact is crucial. Thus, we examined OOPHE levels in Riyadh Province, Saudi Arabia. The data showed that CCA households reported much higher OOPHE than households with no members with chronic conditions, which is mirrored in the international literature [39], [40], [41]. Looking closely into the composition of OOPHE, we found that households with more than one member suffering from health conditions have greater OOPHE for services and medicines due to their complex care and treatment needs. Our findings are consistent with those of the earlier studies [42], [43], [44]. Policymakers may consider moving from a single-disease perspective to

one that includes multimorbidity, especially when allocating financial resources and devising policy strategies.

Additionally, the study examined the relationship between predisposing, enabling, and need variables and the magnitude of OOPHEs among CCA households. Our data indicated that the risk of OOPHE was greater in homes headed by older adults, which is in line with previous results [41]. This increased likelihood is due to greater demand for and utilization of healthcare services by the older generation than by younger age groups. Our research also found that a household head with a higher educational level was associated with a higher level of OOPHE, probably due to higher awareness of the importance of health and more knowledge about healthcare alternatives. This conclusion corroborates research performed in other nations [45], [46]. Our study also discovered that employment status is a major factor. Our finding indicated that employed heads of households are more likely to have larger OOPHE than those who were unemployed. This conclusion is consistent with findings from other nations' investigations [47], [48]. The research found that the "number of family members" affected OOPHE. Increasing family size increases medical care use and OOPHE. China and Serbia had similar outcomes [49], [50]. On the other hand, this finding contradicts Li et al. and Choi et al. [48], [51]. The number of chronically ill household members is a key predictor of OOPHE. As noted, chronic illness prevalence is linked to higher monthly OOPHE. Our results confirm an earlier study on a similar relationship [49]. A member under 14 is another statistically significant indicator of household healthcare costs. The coefficients show that adding a member under 14 to the household increases OOPHE, in agreement with prior research [49], [52]. Further, the need for care in terms of the presence of a member with a disability in the household increases the risk of experiencing OOPHE. Disabled people have been found to have a greater need for healthcare, as many studies show [53]. Moreover, there is a substantial correlation between a disabled family member's presence and chronic illnesses in most instances [54]. Experiencing higher OOPHE was significantly associated with nationality, and this effect was highest among the non-Saudi nationals, which seemed to contradict an earlier study [21]. This contradiction may be due to the differences in methods and population characteristics, as we only focused on those who received care three months before the interview. This is an expected finding as over 80% of non-Saudis work in the private sector [55], which would limit their access to government-run medical facilities. Another unexpected finding was that the level of OOPHE was much greater in urban households than in rural households. This appears

counterintuitive and contradictory to what is observed in other countries [41], [56], [57]. Urban regions may be more likely to have superior medical facilities and specialists, and patients with chronic conditions tend to live in close proximity to them.

Our data suggest that wealthy families are more likely to have OOPHE than poor households. It is safe to infer that the lower class has limited access to medical care and tends to avoid doctors owing to budgetary issues [58]. This finding emphasized the vulnerable position of the poor population when seeking health services. Although data from various countries indicates that insured households incur lower OOPHE [46], [59], our results show that households covered with health insurance spend more on OOPHE. A close look at the connection suggests that health insurance is inadequate to control OOPHE. However, denying health insurance because of this perception may be misguided. Improved access to treatment and greater healthcare use by insured households may explain the high OOPHE. On the other side, it might be due to adverse selection: families make insurance purchase choices based on their estimated risks; thus, those with chronic conditions are more likely to buy the insurance and utilize more healthcare services. Insured households with generous plans face moral hazards from the increased usage of services [60]. Finally, having a regular doctor has a robust detrimental influence on the OOPHE level. Usually, households with a doctor who visits them regularly have better access to preventive services and are more likely to follow the doctor's prescriptions. Consequently, such patients are less likely than others to return for follow-up appointments after an emergency department visit and have lower rates of health and drug complications [61],[62].

The quantile regression analysis results offer supplemental information on how the number of members in a household with chronic conditions influences the household's overall OOPHE. The mean of OOPHE across the number of individuals with chronic conditions in the household indicates an obvious positive increasing pattern along the OOPHE distribution, reflecting that its mean significantly overestimates having an individual with expenditures related to a chronic condition at the lower end of OOPHE distribution and underestimates the difference of medical payments between different numbers of members with chronic conditions at higher quantiles along the expenditure distribution. The result implies that the number of individuals with chronic conditions in a household imposes weaker effects on OOPHE when the OOPHE is at a small scale, and this effect is increased as the OOPHE becomes larger.

It is essential to analyze the potential financial impact of other expenses, particularly for low-income households. Although our data indicate that families with several CCAs incur much higher costs across the quantiles, other expenses may disproportionately impact low-income families, who are also more likely to experience catastrophic health costs. In other words, low-income families may allocate much of their income to other expenses than higher-income families. Policymakers should ensure that people with chronic diseases from low-income families get the help they are entitled to and do not have to carry the financial burden associated with their condition.

Survey data and methodology have certain limitations. First, the present data were based on a cross-sectional survey with self-reported OOPHE, which may be impacted by recall and reporting bias. Second, individuals with untreated chronic diseases were not included in our research. Because untreated chronic diseases tend to develop into other conditions and health issues that impose an additional financial burden, the total OOPHE reported in our research may be underestimated. Third, the research did not examine each chronic condition's influence on OOPHE. Future studies must address these gaps and examine how OOPHE is linked to specific chronic diseases. Fourth, the study sample comprised households receiving care three months before the interview; OOPHE may be overstated relative to the general population.

Despite these limitations, our results have significant implications for Saudi strategy. Saudi Arabia has undertaken several financial reforms as part of its Health Sector Transformation Program. The government has created the Center for National Health Insurance (CNHI), formerly known as the Program for Health Assurance and Purchasing (PHAP), to guarantee that all citizens and legal residents who work in the government sector have access to free, accessible, and high-quality healthcare. People are eligible only if registered at the Primary Healthcare Center, regardless of socioeconomic status [63]. The Center receives funding from the Ministry of Finance, which it utilizes to purchase healthcare services from providers via health clusters. Purchased services are based on a benefits package that is heavily founded on clinical and cost-effectiveness studies to ensure the delivery of appropriate care. The CNHI is currently developing a payment structure to fund health clusters. Before implementation, it must be planned appropriately, and lowering OOPHE should be a priority. Seniors, individuals with disabilities and chronic conditions, and those on social assistance would have lower copayments and subsidized prescriptions. Another

reform is a supplementary health insurance (SHI) system that will allow most citizens and residents to add additional benefits [64]. These reforms are expected to reduce OOPHE and provide financial protection against high OOPHE only if policymakers consider the impact of these policies on persons with chronic conditions and their families. However, their effectiveness can be assessed to improve access to healthcare and reduce OOPHE in families. From the clinical practice perspective, OOPHE associated with chronic diseases can be further minimized by adopting the patient-centered medical home (PCMH) model of care. This model is based on the same principles as the Chronic Care Model, with the primary goal of providing patients with organized, proactive, and coordinated care rather than episodic treatments to improve outcomes while lowering management costs [65], [66].

CONCLUSIONS

Our findings indicate that CCA families pay considerably greater OOPHE compared to not-CCA households. The number of individuals with chronic conditions in a home played a substantial and more prominent role, with a more significant and apparent influence on the higher quantile (vs. the lower quantile). The determinants of OOPHE were studied to identify helpful information for decision-making to reduce the OOPHE among households with chronic conditions. These results may give helpful information to policymakers in the implementation of future healthcare transformation program policies.

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Patient consent for publication Not required**.**

Ethics approval This study was subjected to the Ministry of Health institutional review board evaluation and approved (IRB#00010471). In agreement with the World Medical Association Declaration of Helsinki, the study met ethical standards. The data anonymization and aggregation were used to ensure the confidentiality of the information. Prior written informed consent was acquired from each respondent before carrying out the research.

Data availability statement Data are available upon reasonable request.

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The questionnaire about the household's out-of-pocket healthcare expenditures

1. Formal Consent was provided:
   o Yes
   o No

Predisposing factors

2. Household head gender:
   o Male
   o Female

3. Household head age: ☐

4. Household head marital status
   o Married
   o Not married

5. Household head living condition
   o Alone
   o With family

6. Household size ☐

7. Household head educational
   o Illiterate/read/write
   o School degree
   o Higher education

8. Presence of at least one member less than 14 years
   o Yes
   o No

9. Nationality
   o Saudi
   o Non-Saudi

Enabling factors

10. Household head employment status
o   Employed
o   Unemployed

11. Residential area
o   Urban
o   Rural

12. Having a regular doctor:
o   Yes
o   No

13. Having health insurance:
o   Yes
o   No

14. Households' asset holdings

Type of housing	□ A Traditional Home □ A Villa □ A Floor In A Villa □ An Apartment □ Other Forms Of Housing	Housing tenure	□ House Owned □ Home Leased □ The Home Provided □ Other Forms Of Tenure
Car ownership	□ No Car □ One Car □ Two Or More Cars	Phone available	□ Yes □ No
Television available	□ Yes □ No	Personal computer available	□ Yes □ No
Internet access	□ Yes □ No	Library available	□ Yes □ No
Satellite available	□ Yes □ No	Video available	□ Yes □ No

Video games available	□ Yes □ No		

Need-based factors

15. Household head's level of physical activity
o Active (at least 75 minutes of vigorous activity or at least 150 minutes of moderate or vigorous activity per week)
o Moderately active (1 to 74 minutes of vigorous activity or 1 to 149 minutes of moderate or vigorous activity per week)
o Inactive (0 minutes of moderate or vigorous activity per week)

16. Presence of at least one member with a chronic condition
o Yes
o No

17. Presence of at least one member with a disability:
o Yes
o No

18. Presence of at least one pregnant member:
o Yes
o No

19. The number of members with a chronic condition in the households: ☐

20. Current chronic condition

Dyslipidemia	□ Yes □ No	Hypertension	□ Yes □ No
Diabetes mellitus	□ Yes □ No	Cancer	□ Yes □ No
Thyroid disease	□ Yes □ No	Asthma	□ Yes □ No
Kidney Disease	□ Yes □ No	Psychiatric disease	□ Yes □ No
Congestive Heart Failure	□ Yes □ No	Anemia	□ Yes □ No
Pneumonia	□ Yes □ No	**OTHER**	

OOPHE Components

23. Monthly out-of-pocket on services:

24. Monthly out-of-pocket on medicine:

26. Monthly out-of-pocket on other expenses:

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	9
		(*e*) Describe any sensitivity analyses	9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	10
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10
		(b) Indicate number of participants with missing data for each variable of interest	10
Outcome data	15*	Report numbers of outcome events or summary measures	11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11

		(*b*) Report category boundaries when continuous variables were categorized		11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses		12

Discussion

Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	17

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.